Improving the Use and Reuse of Email in the Context of an Engineering Company

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Improving the use and reuse of email in the context of an engineering company

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List of Abbreviations

AI	Artificial Intelligence
CSCW	Computer Supported Collaborative Working
DRed	Decision Rationale Editor
DRM	Design Research Methodology
HCI	Human Computer Interaction
HTML	Hypertext Markup Language
IP	Intellectual Property
IPR	Intellectual Property Rights
IS	Information System
IT	Information Technology
ITAR	International Traffic in Arms Regulations
KDD	Knowledge Discovery and Data-mining
KM	Knowledge Management
OEM	Original Equipment Manufacturer
PA	Personal Assistant
PDM	Product Data Management
PLM	Product Life-cycle Management
RFC	Request For Comments
URLs	Uniform Resource Locators
US	United States
WMS	Working Memory Span
WMs	Working Memories

Abstract

The use, reuse and manipulation of information has become a key factor in the success of any organisation in an increasingly competitive and global business environment. Ensuring that employees are able to access (or are provided with) the right information in a timely manner is one of the key challenges facing organisations. Amongst the dominant communication methods email fills an important role in facilitating distributed communication and it is seen as a key target for improvement.

Email is being used extensively and increasingly as a significant (and often dominant) method for communication within engineering organisations and projects and there exists significant opportunity and requirement to improve the use and reuse of email.

This thesis contributes a rich understanding of the practise and perception of email use and reuse developed through a comprehensive review of the literature and three investigative studies: a study of the content of emails exchanged during an engineering project, a survey of practising engineers describing the role of email in supporting communication in projects and engineers perception of email, and a investigation of the information about the relationships between engineers participating in a project as represented by their exchanges of email.

The second main contribution is a set of scenarios that were developed to summarise the understanding developed in the investigative studies, and form a core set of contextualised problems that can be used to communicate the research to industry and around which an holistic proposal is described to improve engineers use and reuse of email.

The final contribution is an approach for supporting engineers in interpreting emails by the provision of additional contextual information, mitigating a core problem identified during the course of the research for which a well established information management solution does not already exist.

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As with all knowledge work there is not a word in this thesis that I could have written without the support and past endevours of innumerable, nameless people. Those I am fortunate enough to know the names of and owe a unpayable debt of gratitude to include:

- My academic supervisors, Professor Chris McMahon and Dr Ben Hicks for their support and patience;
- The industrial partner for the research at Converteam UK, Laurie Burrow, who has offered much valuable advice and support;
- My colleagues at the Innovative Design and Manufacturing Research Centre, especially Hamish McAlpine, Philip Cash and James Wasiak for their advice and shared interest;
- All the volunteers who sat through tedious and no doubt baffling interviews for my benefit;
- And of course my wife Sarah, without whose support I would have given up long ago.

Declaration

Chapter 6 makes use of a coding scheme developed by James Wasiak at the Innovative Design and Manufacturing Research Centre at the University of Bath (references are provided within the chapter). The scheme was developed in collaboration with myself and Hamish McAlpine, and the application of the scheme was carried out jointly by myself and James Wasiak.

Part I.

Introduction

1. Introduction

The use, reuse and manipulation of information has become a key factor in the success of any organisation in an increasingly competitive and global business environment [1, 2, 3]. Ensuring that employees are able to access (or are provided with) the right information in a timely manner is one of the key challenges facing organisations [4]. Communication is the process through which this timely provision is generally achieved [5]. With the increasingly global economy engineering projects are becoming more geographically distributed. As a result of this, effective communication in some projects is increasingly difficult due to the distances, multiple locations and numerous participating organisations. Amongst the dominant communication methods email fills an important role in facilitating distributed communication and it is seen as a key target for improvement [6].

This thesis presents the background to the scenario described above, a series of detailed investigative studies conducted to improve understanding of the problem space underlying the scenario, and a study to investigate the effectiveness and practicality of an intervention to address a key aspect of the problems identified.

The starting point for this chapter is the role of information in engineering (§ 1.2). The different methods used for electronic communication and their associated records is reviewed. The role of email (as the most dominant of these methods) is discussed (§ 1.3), including how the particular characteristics of email (as a system) affect the quality and re-usability of records of engineering work. Before discussing the specifics of information and communication it will be helpful to define them explicitly (§ 1.1).

1.1. Knowledge, Information and Communication

In common parlance, communication is taken to have multiple definitions. Primarily it is understood to be a multi-faceted concept which includes the transfer of understanding, the exchange of information (rather than the exchange of knowledge, see Figure 1.1), and the social behaviour associated with the process of transferring understanding [7].

Knowledge is 'what we know'; i.e., our internal understanding of certain concepts, facts and relationships. Knowledge exists entirely within our heads, it cannot be represented explicitly other than through a process of transforming it into information. [8] For an individual to share knowledge with another, that knowledge must be communicated in the form of information. As such, communication can be seen as consisting of two steps, the representation of knowledge in the form of information and the transfer of information to another individual [9]. This transferring of information is achieved through hand signals, speech, graffiti, email, formal reports *et cetera* [9].

Within the context of the previous definitions, and for the purposes of this research, data are seen as 'simple facts', they are that from which 'information' is constructed, by

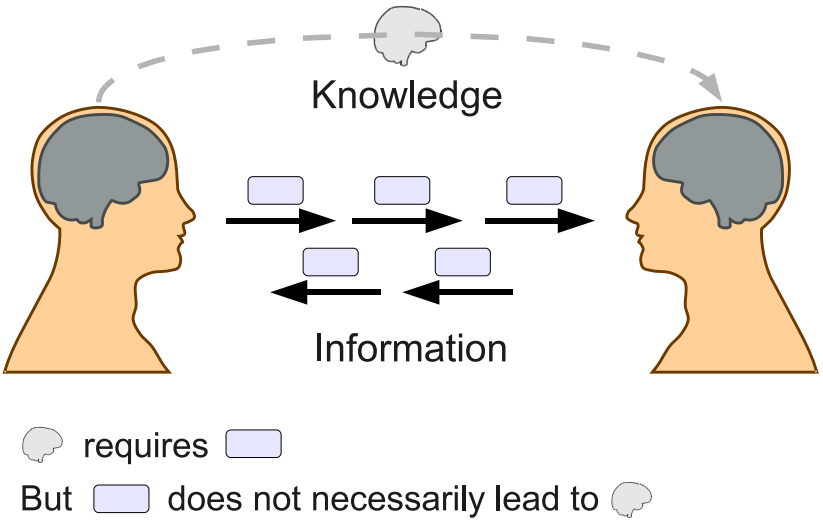


Figure 1.1.: A diagrammatic depiction of communication. The blue lozenges represent information fragments being exchanged between two individuals, with the brain representing the transfer of knowledge from one individual to the other.

means of embedding them in a context relevant to the recipient [9]. This research is primarily concerned with the management of information associated with communication and no further mention of data is necessary.

A crucial consequence of accepting these definitions of knowledge, communication and information is that the effectiveness of a communication act cannot be directly measured. This stems from seeing the goal of communication as being the sharing of knowledge rather than simply the exchange of information. Secondary communication acts will be required to relate the extent of knowledge transferred to allow for the measurement of the effectiveness of the communication act being examined. Also, the effectiveness of these secondary acts will be limited by the tendency of people to: 'not know what they know' [8].

From another perspective, this implies that the single purpose of information is communication, and therefore the creation of information implies the intention to communicate some understanding, even if, as is often the case, the intended recipient is the author himself. Therefore when considering any information its role within a communication act (or series of acts) must be recognised.

The transformation of knowledge into information has been described as 'lossy' [9]. The losses come as the result of two factors: first, encoding knowledge as information is a necessarily incomplete process; an author cannot include (from first principles) definitions for every term and phrase used. Second, even when a carefully developed shared vocabulary exists the product of the encoding and decoding of a 'piece' of knowledge to and from information is effected by numerous biographical factors of the author and reader, the major ones being [7]: Language, Context and Culture. These factors result in interpretive discrepancies in decoding and during encoding affect the representations used and interpretations made during the transformation.

The completeness aspect of a communication act is based on the success of the author in providing the reader with enough context for successful interpretation of the infor-

mation. Obviously, the appropriate amount of context will depend on the background of the reader. The author of a piece of information will intuitively vary the amount of the context provided to suit the understanding of the audience, however, an author's understanding of the audience is never complete and the audience itself may not be a fixed entity [7]. For example, email which are authored for a known audience with which the author has both a shared vocabulary and a shared understanding of the topic would typically contain little context.

Based on the discussion above, for the purposes of this work the following simple definitions are used:

Data are values; free from any meaning

Information is the 'combination of the raw data itself and the meaning to provide the [consumer] with understanding' [10, p.126]

Knowledge is 'the mental state of ideas, facts, concepts, data, techniques, etc., recorded in an individual's memory' [10, p.126]

Communication is the process by which individuals share knowledge through the exchange of information

1.1.1. Information abstractions

Much of this thesis will concern itself with discussions of information and its manipulation, therefore, another point of reference which must be established is the way in which information of differing sorts will be referred to. For the purpose of this thesis, a set [11] of information abstractions of varying scope (see Figure 1.2) will be used:

Information Objects, IO are 'item[s] of information that [have] an object-like form or [take] on object-like characteristics.' [12] i.e., are somehow obviously separate, for example, a document or an email.

Information Fragments, IF are 'any meaningful sub-part of an information object which is meaningful by virtue of the information it contains.' [11] e.g., a paragraph of text or the section of a report.

Information Systems, IS are 'physical or electronic system[s] that [combine . . . collections] of data, information fragments or information objects with the infrastructure necessary to organise, collect, create, disseminate or deliver them.' [11] e.g., a library, or a filing system.

1.2. Information within Engineering

Throughout our species' existence, technological and social development have been facilitated by information. For example, the original creation of an artefact can be seen as the transformation of raw materials into a product using knowledge, however, subsequent inspired or copied artefacts must use information [13, § 1]. A consequence of this constructive use is that information can be seen as having value.

Before the advent of writing, human understanding was held in the form of knowledge and transferred verbally. Writing made it possible for understanding to be externalised and stored, separate from any one individual, as written information. As our society has developed, more advanced means of storing and transferring information have

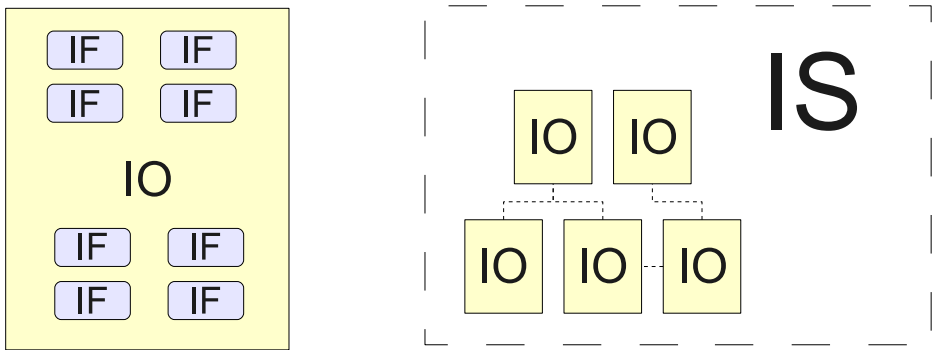


Figure 1.2.: A representation of the relationships between the information abstractions (§ 1.1.1) used in this thesis.

been invented. Today, information can be created and stored anywhere, and (nigh on) instantly accessed an unlimited number of times from anywhere else!

Information is now one of the most important resources to the modern Organisation. In response to this, much research is being conducted in the general fields of information management [6, 14, 15], research that is of specific interest is that concerned with the long term organisation, storage and reuse of information. In relation to this issue the industrial partner for this work has identified its long-life projects as those particularly in need of better information management. With long-life projects issues such as changes in staff, technology, and the economy combine to magnify the effects of poor information management. They have identified the problems surrounding the management of email in long-life projects as of particular concern – project managers within the Company have reported that valuable information within email systems may be very difficult to find.

The role of information in supporting engineering work is well recognised [16, 17]. Studies have shown that engineers can typically spend 20 to 30 % of their time utilising or manipulating information [18]. This is a clear indication of how critical effective information management is to engineering firms. It has been observed that improving the information and knowledge management practices of engineering firms can result in direct improvements to the quality of outputs and lead times [19].

A number of factors have been seen to influence information management within engineering [4]. Engineers create and access a wide variety of information sources and communicate them across numerous channels [4, 20]. Typical projects will see an engineering firm interacting with multiple parties (customers, partners and suppliers) each with their own procedures for working and protocols for communicating [4]. Projects spanning multiple decades magnify the need for better information and knowledge management practices due to the turn-over of staff, both within the company and in those being interacted with. [4]

1.3. Email

Despite the rapid growth and widespread use of email it has traditionally been seen as an informal (and perhaps personal) communication tool, perhaps due to the ease with which users were able to exchange messages [6]. The overheads associated with communicating over large distance were reduced almost to nothing, and for co-located

workers new affordances were provided. Uptake in email use has been generally driven not by central organisational pressure but by its popularity with users. The result of this is that many companies do not have central policies to guide employees' use of email or to manage the large collections of email which their employees are producing [22]. Some companies do make use of databases or archives for the storage of email, however, these are rarely intended (or allow) for access, study or reuse of the email within.

1.4. (Re)Use

Use, in the context of this research, refers to interpretation of Information Objects. Interpretation being the process of acquiring knowledge through the decoding of information, e.g., reading and understanding. When considering the use of email (as information objects) it is also convenient to distinguish reuse , as being the use of email by actors other than the original recipients. It may also be appropriate to include the original recipients using the email again after a significant period of time, i.e., after they have forgotten/lost the context of the original use.

Now that email has been established in the workplace for a significant period of time the problems with the current disorganised system are beginning to become apparent to users and managers [6]. The problem which initiated the research reported in this thesis relates to the tracking of decision rationale within long life design projects. It is not uncommon for large engineering projects to take decades to transition through the active phase of their life-cycle. During these projects the individuals involved will change, they will retire, be promoted, and move on to other projects. Difficulty in tracking design rationale and decisions throughout the life of the project is one of the immediate effects of this flux of people. It has been suggested that this problem has been compounded by the use of email; if rationale is stored, communicated or developed using email then when an individual employee leaves an organisation the information present in the employee's email may be lost or become difficult to access. [1]

1.5. Summary and Research aims

It has been discussed that information is important, and increasingly so, to engineering firms. It has been suggested that the nature, prevalence, methods, tools and procedures associated with email use are poorly understood, meaning there exists significant opportunity and requirement to improve the use and reuse of email, particularly within engineering.

The problem expressed below attempts to concisely describe the conflation of factors that make this research important and timely. The research aim that follows sets out the intention and direction of this research project.

1.5.1. Research problem

email is being used extensively (and to an increasing extent) as a significant (and often dominant) method for communication within engineering organisations and projects.

The current practices for writing and distributing email do not result in comprehensive records of the work, that are intelligible to future users, or to automated processes.

[1] Communication with Industrial Partner

This is because the Information Objects produced do not explicitly incorporate the immediate environment (the Project, Process, work task and team) or allow for the consistent determination of the nature of the communication activity that they represent.

1.5.2. Research aim

The background and problem set out in the preceding sections highlight the importance and increasing urgency of this issue as a research topic. This research aims to develop a rich understanding of the use of email, the perception of email and the utility of information in email. This will be achieved through an assessment of literature and the use of investigative studies. With the driving objective of improving the direct use of email and the longer term reuse of the information within email, the understanding developed will then inform the development of an holistic approach to improving email (re)use.

1.6. Thesis structure

This thesis is divided into 4 parts: Introduction (I), that reviews the background, context and critically assesses the relevant literature; Investigation (II), that introduces the 3 principal studies undertaken thus far; Intervention (III) that summaries the lessons from the investigations, introduces the proposed interventions developed from the new understanding and describes the implementation and evaluation of the most important proposal; and Conclusion (IV) provides the discussion and conclusion of the research undertaken. The structure and content of each part is outlined in the following sections.

1.6.1. Part I Introduction

Chapter 2 presents the context for this thesis by providing a review of the engineering specific background and environment in which the issues identified in the following chapters must be considered.

Chapter 3 is a critical review of the literature to identify the role of email and the issues and opportunities associated with its use within engineering as well as the work from within the management and computer science communities on improving email clients and systems.

Chapter 4 describes the chosen methodological framework for the research, with reference to the introduction and literature reviews formulates research questions, and finally sets out the programme of work devised to meet those questions.

1.6.2. Part II Investigation

Chapters 5 to 8 make up Part II of this thesis and present the investigative work carried out to date. These investigations provide the core descriptive component of the research, in combination with the review of the literature presented in Part I. In Chapter 3 a large number of issues and opportunities were elicited from the literature and analysed for their relevance to engineering work. Those issues were identified as falling into one of 3 classes (§ 3.3): Context, Understanding and Behaviour. Investigative studies were targeted to improve our understanding of each of these classes.

Chapter 5 describes how through the industrial partner access to the email, documents and several engineers, from a particular project of a large multi-organisational and multi-national project were obtained (See Chapter for details). This corpus of documents provided a rich opportunity to improve the understanding of the use of email within engineering.

Chapter 6 describes the first study, which was a qualitative analysis of the content of the email corpus that investigated the character of the messages that engineers exchanged during the project. The character was assessed by a manual process using a coding schema to describe what the email were about, why they were being sent and how they were expressed. How the character of the messages varied with time was also examined. This investigation made use of the project documentation as well as interviews and reviews with the project engineers to reinforce confidence in the findings.

Chapter 7 describes the second study, which used a survey to investigate the practice and perception of email. This study was used to reinforce the issues identified during the literature study and to provide data with a large enough sample such that any findings may be generalised to apply to the UK engineering community.

Chapter 8 describes the third study, investigated the participant element of the email data by performing a network analysis on the email corpus provided by the industrial partner. The study looked at patterns of relationships in the context of the roles of the individuals participating and also for the phase of the project that a particular relationship is significant in.

1.6.3. Part III Intervention

Chapters 9 to 10 make up Part III of the thesis; they present the proposed intervention based on the understanding developed through reviews and investigative studies.

Chapter 9 summarises the requirements identified through the investigative studies (Part II), and develops the requirements into a series of proposed interventions to improve email (re)use. The proposal to add context to email to support interpretation is identified as that least explored by existing research.

Chapter 10 describes the implementation of a system to evaluate the principle proposal, the design of the associated tests and the results.

1.6.4. Part IV Conclusion

Chapter 11 summarises the research and its contributions to knowledge, and provides recommendations for implementation of the interventions suggested in industry and recommendations for future work.

2. The Context: Engineering

This research takes place within the context of the engineering domain. There is a wealth of research on knowledge, communication and information in engineering. This chapter will present an overview of that research with an aim of highlighting those characteristics of the domain which bear upon electronic communication methods.

Pahl & Beitz describe the role of a design engineer as being the "mental creation of a new product" and go on to describe Engineering design as positioned between 2 intersecting streams of activity: the cultural and the technical [24]. In doing so they highlight that engineering design is more than just a technical discipline, the following sections will include many of these non-technical aspects of engineering design that effect the way engineers communicate.

2.1. The Life-cycle

In engineering the concept of 'life-cycle' appears in a number of contexts, particularly: project life-cycles and product life-cycles [25]. The concept itself represents the notion of the properties of an entity or system changing with time, but changing along a predictable and finite path; i.e. deterministic and non-repeating.

Understanding and being able to predict life-cycles and plan based on that understanding of can lead to rationalisation of engineering work and improvement in efficiencies. From an information management perspective such an understanding also allows for Information Objects to be associated with stages in the life-cycle.

2.1.1. Project life-cycle

Engineering design work does not standalone; design work is supported by other activities that facilitate the design process, manufacture the resulting design, and sell the product. Eckert (2001) describes engineering projects as taking place in large organisations, with complex teams working under equally complex managerial structures with additional management structures associated with business and financial management of the organisation [4, §2].

A project can be considered, as can many activities, as having a discrete start, middle and end. These three phases of a project are named variously by different sources but they can be roughly described as [26]:

1. Negotiation, specification, concept definition
2. Design, manufacture, ramp-up
3. Exploitation, selling

These 3 stages can be seen in many models of the design process: Pahl & Beitz [24] and Pugh [27]. Floricel & Miller describe the characteristics of these different stages in detail [26].

2.1.2. Product life-cycle

The discipline of Product Life-cycle Management (PLM) aims to cover all aspects of the information, knowledge and communication throughout a product's life. Stark (2004) sees the need for PLM as being driven by numerous reasons, amongst which he mentions: activities spread over multiple organisations, the increasing complexity of products, reducing time available for development and the shift to service dominated product offerings [25, p.3].

Stark describes the five phases in a product life-cycle, from the perspective of a manufacturer as being: imagine, define, realise, support service, retire, and then describes PLM as providing "visibility and control" over the activities that are carried out within each of these phases [25, p.105]. Stark then builds on that, to describe that for these activities to be managed the information representing them must be arranged with respect to the organisational structure of the "extended enterprise" [25, §9.3].

An alternative perspective to PLM comes from marketing; Gartner use a related concept of the 'Hype cycle' to describe how the development of a product concept and public perception of it change with time [28]. They describe such a cycle as consisting of 5 serial phases: the 'Technology Trigger', 'On the Rise', at the 'Peak of Inflated Expectations', the 'Trough of Disillusionment', the 'Slope of Enlightenment' and the 'Plateau of Productivity' and 'Post Plateau' (Figure 2.1). They use this to track and predict the prospects of particular technologies or products.

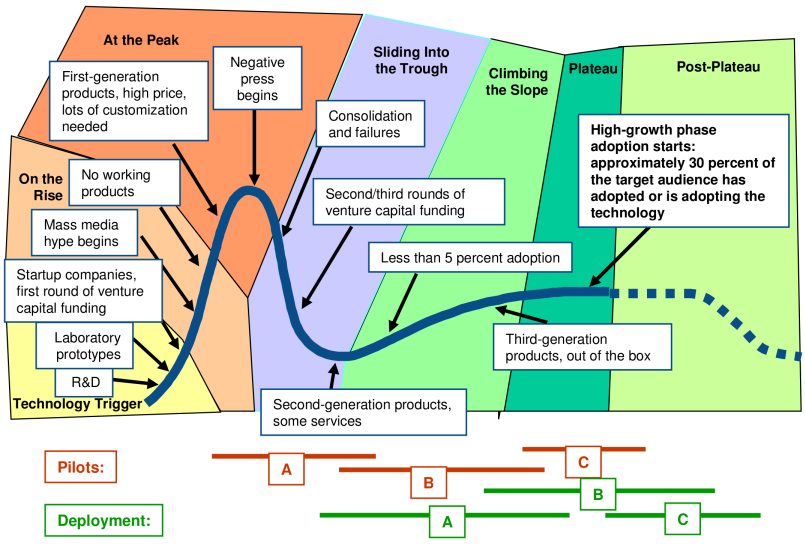


Figure 2.1.: A diagram showing the different phases of the Gartner Hype Cycle (Source: Gartner, Inc. [28]).

2.2. The Project

Engineering design work does not take place for its own sake; it forms part of a programme of work, generally for the meeting of a customer's specification. This programme of work is guided and facilitated by managers, who ensure that members of the project communicate and collaborate effectively [29]. The following sections introduce aspects of engineering project work that impact on effective communication and information management.

2.2.1. Cost Commitment

One aspect of the design process which must be considered is the stage during the process at which costs are committed and costs are incurred. The committing of cost to a product relates to the cost associated with a particular feature of a design and the cost associated with producing a design including that feature.

Ullman has shown that the major proportion of costs are committed during the specification and concept development stages of the design process [30]. This emphasises the importance of cost estimation at the early stages of the process and, associated with this, the need to learn about patterns of cost committal and incurrence from previous similar projects. This learning from previous projects requires good records of interdisciplinary working and effective collaboration and communication.

2.2.2. Working together

The design of complex products can involve thousands of engineers distributed across the globe. Eckert et al. highlighted the difficulty an individual or a small group working on a specific aspect of the design will have in understanding the product as a whole [5, p.2]. In particular this means that they can have difficulty understanding their interfaces with other sub-systems and hence other engineers. Flanagan et al. point to the importance of engineers understanding what they are expected to communicate and when, and who they need to seek information from to continue with their work [29, p.3].

The organisational structure of the company may significantly influence the effectiveness of communication between engineers in separate divisions of the organisation as engineers are often required (or at least expected) to communicate through the hierarchy and this may act as a barrier to efficient communication [4, §5.3]. This is particularly the case when those in the upper levels of the hierarchy are heavily loaded individuals, who will effectively become bottlenecks [31]. This may have particularly strong implications for learning from previous projects which took place outside of the new project's design group.

Knowledge churn

The natural turnover of staff in long life projects [32, pp.42-43] as the result of promotion, resignation, redundancy, retirement, reallocation etc. results in a continuous flux of the knowledge 'held' by the members of a project.

Many engineering firms have introduced debriefing policies[1], which require the leaving members to either act as mentors to their replacements or to have their knowledge 'elicited' for the purpose of producing a record describing their role and the knowledge they held.

Aside from the problem of knowledge 'loss', Giess et al. also considers the problems associated with an individual's document store and correspondence as an important information management issue. The content and organisation of such stores will typically not be easily and intuitively intelligible to another person, even another member of the same project [33, § 2]. This issue has become more acute with the ascendancy of

[1] Communication with Airbus and Rolls-Royce KM employees

electronic communication systems e.g. email, which is increasingly used for the communication of valuable engineering information is facilitated by systems that are not designed for long term storage and retrieval [6, p.7].

Virtual working

The increase in distributed working has led to the practice of creating teams that are not co-located and that work directly with each other using electronic communication mechanisms such as email, Tele-conferencing, and collaborative document authoring. Such virtual working allows for organisations to quickly and cheaply form, disband and reform teams to meet changing work loads, it also facilitates 24hr working and attempts to mitigate the interface problems described previously [34, p.6]. Virtual teams, however, also introduce different issues of their own. Many of these problems stem from the difficulty in creating teams from diverse and distributed individuals. Teams are characterised by the relationships between their members, they are said to have 'interdependen[ce] in their tasks [and ...] are seen by [themselves and] others as an intact social entity' [35, p.241]. From an engineering perspective the major issues include [34, pp.8-13][36, pp.792-794]: development and maintenance of trust, cultural differences, organisational differences, process and task co-ordination. Effective communication, both in terms of efficient and appropriate exchange of information, but importantly also the skill of individual members as communicators is key to mitigating problems in virtual teams [34, p.11].

Interdisciplinary work

Another changing aspect of engineering work is the increase in interdisciplinary work. This may be associated with virtual working, but is perhaps more clearly related to the increasing complexity and integrative nature of modern engineered projects, and the practice of concurrent engineering. Many of the issues associated with interdisciplinary work are the same as those identified for Virtual working. Here, however, some issues such as a common vocabulary and common conceptual models are of more direct concern [34].

2.2.3. Contracts

Projects often (perhaps invariably) involve a number of partners and suppliers (and other organisations) working together at different phases [5]. Contracts are used to attempt to control the level of risk any one organisation is exposed to as a result of the project, and to try to ensure that each organisation meets its obligations. These contracts form a complex web of requirements, constraints, responsibilities and punishments which bind together the project. A number of anecdotal problems raised in interviews carried out as part of this investigation relate to the problems with the management of contracts that result from informal communication; if an engineer from one company sends an email agreeing to a particular performance characteristic of a product then it could (and often will) be a contractually binding statement [2].

Engineering firms employ engineers dedicated to understanding the organisation's contractual requirements and obligations. They are tasked with ensuring that changing requirements are managed, and change in the best interest of their organisation. They also examine and assess the current state of the contract to ensure that undue costs are not passed on to their organisation.

[2] Interviews with engineers in Industrial Partner

2.3. Communication

In the introduction (§ 1.1), communication was defined as 'the process by which individuals share knowledge'. Darlington describes engineering work as involving intensive communication [21] that takes place rapidly and widely during the design process with the involvement of a wide variety of parties, from local suppliers to globally distributed risk sharing partners. To share knowledge, engineers (like everyone else) encode their knowledge as information and then exchange that information with another individual. The following sections will describe the mechanisms available to engineers to exchange information and the information representations that they use to encode their knowledge.

2.3.1. Different mechanisms

There are many mechanisms available to engineers by which to exchange information. Huet comments that these mechanisms can combine visual, audible and tactile cues to allow for manifold possibilities [37, p.51]. The inventiveness of our species has lead, most notably, to: letters, email, telephone, facsimile, video conferencing, instant messaging, television, newspapers.

Eckert et al. identify two dimensions of classification that can be used to usefully distinguish between the different mechanisms available [4, p.23]. The extremes of these two dimensions can be defined as:

Synchronous a response is expected to follow immediately e.g. telephone.

Asynchronous an immediate response is not expected e.g. letter or email

and

Face to face co-located, interpersonal communication e.g. a design meeting

Distributed geographically separate e.g. a video conference

A communication mechanism's synchronicity, how well it facilitates distributed exchange, and the balance of the audio, visual and tactile cues that it provides, all contribute to the suitability of the mechanism for a given role.

The increase in distributed working has seen the rise in importance of those mechanisms which allow for distributed asynchronous communication. The most compelling evidence for this observation is the relatively meteoric rise of email as the preferred method for much communication [38]. The demand for the asynchronous and distributed aspects of email has offset the relatively low level of detail and structure that it is practical to use in email. Although, Ducheneaut & Bellotti also point to the affordances of its digital nature as an additional reason for email's success [39, p.36].

2.3.2. Representations

Information is generated continually throughout an engineering project. It is manifest in documents of multifarious form, format and function [18, 20]. Aside from the common representations that all knowledge workers will be familiar with there are also those which are particularly relevant to engineering: log-books, 2D and 3D drawings, and geometric and analytical models [40]. The following sections discuss the two principal dimensions, formality and concision, along which information representations can be usefully differentiated.

Formality

Formality, here, is taken as being the level of context and structure provided to the reader, such that they are able to more closely infer from the source the knowledge which the author intended to communicate. Hicks et al. identified formality as an important characteristic of information which is related to differing requirement of capture, storage and reuse [1, 41].

McAlpine has worked to better define informal information, adding that it is sometimes equivalent to or more effectively considered as personal information [41, 42]. Lowe (2002) identifies a number of personal information stores as being of interest in the engineering domain: "memos, faxes, email, meeting minutes, company reports, journal articles, calculations, collections of drawings, guideline extracts, catalogues, presentations and loose text & drawings" [20]. A survey of engineers by Lowe (2002) confirms the importance of these personal information stores reporting that engineers refer to them for as much as 45 % of their information needs.

Concision

The dimension of concision concerns the level of detail represented by a particular form of information (i.e., how concise it is) [43, § 2.52]. In the introduction is was explained that the process of creating information necessarily results in some loss relative to the knowledge of the author; however, further than that, the particular form of representation which the information is being created in will also either limit or restrict the level of detail, contributing a further loss.

A related phenomenon occurs during the synthesis of information objects, in which, the derived information object represents only a summary of the previous objects. This is often termed, somewhat erroneously, as "information loss" [37]. It has been described in terms of a *loss* to emphasise that valuable information is often lost as a result of it only being the summary objects that are accessible and/or retained. However, describing it as a loss neglects the important role that summaries play in providing appropriate levels of access to understanding beyond the original author(s) of the information and their peers. An immediate example is the executive summary provided at the beginning of *this* information object (the thesis), which will have a much greater audience than this paragraph.

2.3.3. Trust, and certainty

Having found an information object of interest, it is just as important that the information seeker is then able to assess the suitability of that information object with respect to their particular needs [33]. The following sections describe 2 characteristics of information objects, trust and uncertainty, that affect their suitability for particular applications.

Trust

Cloonan et al. used interviews with engineers within an OEM and its supply chain to explore the impact of trust and power on knowledge sharing [44]. A lack of 'formal awareness' of the personal aspects of extra-organisation relationships was reported, a consequence of which was the absence of practices for supporting the development of trust [44, p.1075]. From the interviewees 4 main factors were identified as affecting

trust: "timely communication, consistent information sharing, personal networks [and] exploring trust levels" [44, p.1074].

Old fashioned 'networking' was seen as being of crucial importance in developing personal trust. One engineer describing "having a drink with people" as "worth more than 1000 novel team building exercises" [44, p.1075]. Hertzum has also highlighted the importance of trust when seeking information [45].

Uncertainty

In engineering design, uncertainty refers to a real or perceived 'lack of knowledge' about an aspect of a future product [46, p.280]. Far beyond implications just for information seekers, Grebici et al. propose that uncertainty is an inherent characteristic of the design process [46, p.280]. In a further indication of its impact, Hatcheul & Weil use 'the degree of confidence that [a designer] assigns to a proposition' as the governing mechanism in their universal design theory [47, p.5]. Putting aside such grand ambitions, the level of certainty with which a particular statement can be made is intuitively of value to someone assessing an information object. The level of certainty associated with a particular information object can be viewed in terms of its 'maturity', with Grebici et al. defining immature information in an engineering context as being 'uncertain information (unstable, imprecise, incomplete etc.) which can cause significant impacts on the collaborative design process' [46, p.280]. Grebici argues that for effective collaboration it is important to support the evaluation of the maturity of Information Objects [46, p.282]; and goes on to suggest that a reliable proxy for maturity is the relative closeness (in terms of storage and visibility) of an Information Object to the author(s).

2.4. Summary

This chapter has described some of the aspects that determine the effectiveness of engineering work. Not all aspects will affect all projects, and the aspects can and do combine to produce more complex situations than would be the result of any single aspect.

This chapter is intended to introduce the context in which this research takes place. It has informed the scope and direction of all the subsequent chapters. For example, Chapter 7 reports on a survey that ask participants describe the different types of communication mechanisms (§ 2.3) they use and the kinds of teams they were a part of (§ 2.2.2). Chapter 3 builds on the background and concepts that emerged in this chapter to provide a more detailed and specific picture of the issues and challenges associated with the use of email in engineering.

The chapter has highlighted recent research that has identified the importance of distinguishing between the formality of information representations and the level of concision. Additionally, the recognition of the role Trust and Uncertainty play in influencing how engineers use and interpret information.

2.4.1. Contributions to knowledge

- Summarised the context of information management and communication in the engineering domain.

3. Critique and identification of issues

In Chapter 1 the case for improving the use and reuse of email within engineering was presented and in Chapter 2 the engineering background and context were described. This chapter continues the literature review, but with the specific goal of identifying in detail the issues and opportunities that underlie the research problem developed in the introduction (§ 1.5.1), but before that the general field of existing research in this area will be described, to introduce the types of literature that will be referenced (§ 3.1).

3.1. Associated research

Information is now one of the most important resources to the modern company. In response to this much research is being conducted in the field of information management [14, 15]. However, in the initial background research for the work, reported here, it became apparent that the issues associated with email within the context of engineering are not well understood. Furthermore there has been little or no work done within the engineering community to explore the opportunities of email for improved information management and improving communication. This chapter will draw on the literature from across the computer science, linguistics, computer supported collaborative working, management and engineering communities to identify issues and opportunities in how email is used, and identify the implications within the context of engineering.

A previous review of email literature [48] from within the Computer Science community identified 3 "metaphors reflecting the 'collective imagination' of different disciplinary fields regarding e-mail". They describe the primary focuses of the different branches of Computer Science. The three metaphors are,email as a:

Filing cabinet Focusing on the individual's use of email and particularly the challenges associated with effective categorisation of email to minimise overload and to aid retrieval. The lack of research in relating email to work and practice is highlighted. This field is dominated by the Human Computer Interaction (HCI) and Artificial Intelligence (AI) communities.

Production facility Focusing on collaboration, work flow, effective communication with project groups and organisations. Research in this field is primarily conducted by the Computer Supported Collaborative Working (CSCW) community.

Communication genre Focusing on the effect of email on, and its utility for improving, organisational effectiveness. Research in this field generally falls under the heading organisational studies and information systems research.

The review then described the research in each of these fields with reference to these metaphors. However, specific issues and opportunities were not identified clearly. While this review does separate the high level functions of email in general it does

not reflect the facets of email that pertain to Engineering particularly with respect to information and knowledge management. To aid the construction of a solution for improving the use of email for engineers it is necessary to more clearly identify what issues and opportunities are currently recognised in existing research and determine which have most bearing in the engineering domain. Therefore an alternative categorisation to separate out the issues and opportunities as identified through the literature, which are introduced in the following section, on the basis of their relationship to the management of information and support for communication and knowledge creation was created and is described below. The following four overlapping areas will be used for this categorisation:

- Collaboration and communication – affecting team working and the discussion and exchange of information and ideas
- User – affecting the work of individual users
- Records – concerning the documentary evidence of a project or activity
- Knowledge creation – concerning organisational learning

This categorisation is not an attempt to develop a robust distinction between the issues but is intended to guide in the discussion of the issues for the purposes of this report. A further distinction is applied to aid in the identification of the context to which particular issues are most pertinent:

- General – issues associated with use of email across all domains
- Derived – issues identified which are not directly associated with the use of email but which arise from the information which it affords
- Engineering – issues which are of particular or exclusive importance in the engineering domain

These categorisations are elaborated on and discussed as they are introduced in the Chapter.

3.2. Issues and Opportunities

The issues and opportunities are divided into 3 groups to indicate the context in which the issues are most relevant. Within each of these groups a summary of the research will be presented as well as some general points of discussion. Figure 3.1 presents the issues and opportunities that are identified, categorised using the scheme described in the previous section.

3.2.1. General

Much of the research conducted in this area has been done under the banner of Computer Supported Collaborative Working (CSCW) and Human Computer Interface (HCI). The following issues comes from research which can be roughly divided into the following distinct strands: the functions to which users put email [49], the effect of email on the performance of employees [50], the cognitive problems associated with the classification of documents [51, p.107], and the difficulty in associating disparate conversations with a work process [52].

1) Organisation of email archives The act of categorising email (and other digital documents) is a cognitively difficult task [51, 53, 54]. This difficulty is increased in a business context by the dual requirements of categorising for the use of the individual and for use by the organisation. Whether or not categorisation is required for an employee to work effectively [50, 51], it may be required for their employer and colleagues to make effective use of their email archive [33, p.2].

2) Interruptions to work Before the ascendancy of email employees would have letters and memos delivered once or twice a day. Emails now arrive in a continuous and unpredictable stream throughout the day, which leads to many more interruptions to work. Studies have found that it can take 64 seconds for an employee to resume work having read an email. Work undertaken within the management research community has claimed that significant costs are associated with these interruptions [50].

3) Information overload Studies of users and of the increase in the global exchange of information have reported that individuals are receiving more email than they can consistently, thoroughly and comfortably deal with [22, 49]. As well as the cost associated with the interruptions to work, stress, frustration and reduced effectiveness have also been identified as consequences of this increase in information exchange [6].

4) Overloading Email Although email is primarily used as a communication system studies have reported that individuals put their email systems to a number of other uses [39]. This includes the arranging of meetings, the maintenance of task lists, the archiving of files, and as a reminder system. Current email systems and standards do not define or restrict the type of usage [55]. This can influence peoples' ability to handle information overload by requiring further work to transfer information from email applications into their preferred applications [49, 56].

5) No formal structure Users often see email as being an informal communication mechanism or only use it for the exchange of short messages and therefore consider templates or other methods of introducing structure a hindrance. Few organisations provide employees with guidelines or training on the use of email [6]. For the sending of standardised messages such as meeting requests or maintenance records these messages would be more effectively included in a record keeping systems if they were sent using prearranged templates [57].

6) No relation to process When an email is sent it has no explicit (or machine interpretable) relation to any processes that the sender is currently involved with [52]. A recipient will often be aware of the process, task or activity which has triggered the email; however, if they are not then the recipient may not have sufficient context to understand the message. When considering the long term retrieval of messages the presence of contextual information is essential to successfully understanding the message [39, 48].

7) Requirement for retention "E-mail now has an important role in contractual situations and is required evidence in any litigation where its content may be very important to establish design intention however unwittingly it was recorded in the e-mail". [1] However, many companies still allow employees to decide which email are

[1] Communication with Industrial Partner

appropriate to keep, whilst often not providing any guidelines for making those decisions [6].

8) Identification of value Many companies have no procedures or guidelines to encourage employees to identify those email of long term value and present them for archiving as part of a central record keeping system (this is related to Issue 1) [6]. This makes having a central record of a project difficult to produce or of little value; as a result of there being either too little or too much content in the record.

9) Distributed record Contemporary commercial email systems will often not have (or not be configured to use) a centralised storage facility for email. This results in email being deleted or being inaccessible due to poor management at an individual level [6]. This relates to Issues 7 & 8: the requirement for retention is made difficult if the email are not stored in a centrally managed archive, and the identification value is left entirely in the hands on the individual employee.

10) Integration with other records Natively email does not have a mechanism for relating an email to other (non-email) documents (except via attachments). Establishing relationships (links) between discrete Information Objects is important for producing a consistent and complete project record [58]. Most email clients will interpret hyperlinks, allowing for external referencing as long as an organisation's Information System provides URLs for documents stored within it.

Attachments are not a suitable way of providing references to additional Information Objects because they produce a local, static copy of the Object rather than providing a reference to its source which not only unnecessarily consumes storage resources but also makes following versions of a document difficult [59, §5].

3.2.2. Derived

The work in this area comes predominantly from the management community. It is primarily concerned with organisational level issues, such as: consistency of extra-organisational communication, gaining and understanding of expertise sets using email and the mapping of informal employee networks.

11) Managing organisational communication Company organisational structures often prevent the free flow of information between employees. Communication between functional groups may have to follow a vertical route up and down the chain of command [4]. This can lead to problems if communication bottlenecks form when individuals with a large number of subordinates are overwhelmed by the number of communications they have to approve [60]. Monitoring the flow of email can allow for the people who act as key communication nodes to be identified. This has been identified as providing a number of insights into organisational practice and potentially also allowing for these key communicators to be provided with greater support. Research has also been done to understand the relationship between the formal organisational structure and the informal structure (represented by communication between employees) [60].

12) Communities of practice Communities of practice are informal groupings of employees within an organisation. These communities develop naturally within organisations as a result of shared interests and goals [61]. Techniques have been developed

to use email communication records to identify communities of practice [61]. These techniques work by analysing the relationships between employees and identifying subgroups of these employees within a larger network.

13) Expertise Mapping Discovering who knows what within any medium to large organisation is often difficult [62]. In a similar way to identifying knowledge of external organisations (as discussed in Issue 14) it may be possible to identify those employees who hold key expertise. Techniques utilising a combination of social network analysis and content analysis have been developed for expertise identification [62, 63]. For example, a study of practice within Rolls-Royce confirms the value of these techniques by reporting that designers sourced 82 % of information from people they knew [64]. Expertise Maps by providing an index of expertise associated with each employee, would allow users to more quickly identify colleagues capable of providing the information or expertise they seek.

14) Spheres of Influence When tendering for a new contract or negotiating with a supplier an organisation can gain an advantage by utilising knowledge from previously existing relationships. Other than for certain high-profile relationships it might not be clear that an organisation has been dealt with previously. By employing a similar process to that used for Expertise Mapping (13) it would be possible to establish a record of which external organisations an organisation's employees are in communication with. An employee communicating with an external organisation can be seen as evidence of that employee having knowledge of that organisation. Such a process would also aid the identification of those employees who are key to the maintenance of important extra-organisational relationships.

3.2.3. Engineering

This section gathers issues from many research communities which are of particular relevance to the engineering domain. It also explores some general engineering information management issues and their relationship to email. Most of the issues identified centre around the assumption that the management and securing (both restriction and long term storage) of information (as the primary value constituent of design work) is particularly crucial to the long-term success of engineering firms.

15) Multi-disciplinary teams Engineering projects often rely on dynamic, mixed discipline teams, with people of different expertise, backgrounds and practices all collaborating on a project [4]. This increases the need for more detailed inclusions of contextual and background information as different participants in the engineering process will "express ideas [differently], and [have] different skills for creating and interpreting diagrams and other visual representations" [4]. This applies particularly to email, for which, as static representations of one person's interpretation of a requirement/state/problem, even considering attachments there is limited scope for reinterpretation [5].

16) Communication in complex projects Engineering projects often consist of many collaborating companies. Even on simple projects a firm may rely on a number of suppliers or consultants [4]. In such complex projects effective communication of information becomes simultaneously more difficult and more important.

Email is a key mechanism in the communication of information throughout the life of engineering projects, from the initial negotiation of specification through to in-service support, however, records of these communications are often not effectively managed[2].

By effectively managing these communications an organisation could present a more consistent image to an external company and fully utilise existing information about a company to their advantage (as discussed previously under Spheres of Influence, Issue 14).

17) IP protection One of the central issues associated with the management of information in complex multi-organisation projects is the maintenance of intellectual property rights (IPR) [32]. Participants in a project may in other circumstances be direct competitors. Therefore it is particularly important that through the collaboration no competitive advantage is provided unnecessarily.

Related to the problem of protecting IP from competitors is that of restrictions on distribution imposed by national regulations. An example of such is the United States' International Traffic in Arms Regulations (ITAR); these regulations restrict the transfer of military technology to any non-US citizen [65]. This causes particular problems for branches of transnational companies operating in the US, who may be prevented from sharing sensitive information with branches in other countries[3].

The rapid copying and exchange of digital documents using email, has increased the risk that information will be inappropriately shared resulting in loss of competitive advantage or legal action. Having said this a more effective and ever pervasive mechanism for technology and knowledge transfer in engineering is the simple turn-over of staff [32].

18) Rationale capture There are a number of tools for the capture of the results of decision making processes within engineering (such as the Decision Rationale editor (DRed) [66]), however, these often focus solely on meetings, as these provide a concentrated source of design decisions. With the move to more distributed working these decisions are increasingly being communicated (recorded) in asynchronous communication activities rather than in meetings. The email records of a project can thus become the primary record of design decisions.

Although a decision may not be explicitly made 'within' an email exchange, email certainly can provide information to help understand why a particular decision was taken, when it was taken and who was informed [67].

19) Relationship to design artefacts Perry identifies artefacts when seen as 'Objects of interaction' as essential to effective communication of design information [68, p.275-276]. Perry describes two sets of artefacts that engineers interact with during the design process: design and procedural. Examples of design artefacts include: 'plans, models, prototypes, and visualisations', and examples of procedural artefacts include: 'forms, change requests, [...] letters, schedules' [68, p.275].

Many email exchanged during the course of an engineering project are sent along with formally produced documents (provided as attachments to the email)[4] but do not

[2]Communication with Industrial Partner
[3]Communication with engineers at Rolls-Royce
[4]Observations from Industrial Partner email corpora

make any reference to the underlying design that describes the 'position' of a particular email or its attachments within a project. Also, this practice encounters the problems of exchanging documents by email, as raised in Issue 10.

20) Communication record Long-life projects can last for 50 years or longer. The barriers that act to prevent the effective recording of information and the reuse of those records in long life projects are primarily associated with changes that will occur with the passage of time: the engineers involved with the project, tools and methodologies, the stakeholder organisations, and also the terminology [69]. The barriers impact the familiarity of engineers with the project they are working on, making information more difficult to find, and once found, more difficult to understand. The effects of these barriers have been highlighted by industry as of major influence in the effective management of their information[5].

Engineers are often left to manage their own email retention (Issue 7) and categorisation (Issue 1), which makes email particularly vulnerable to changes in the engineers working on a project.

21) View of the design process Much research has been conducted within engineering to try to better understand the design process (with a view to improving its management). Ethnographic studies have shown that engineers rarely follow the prescriptive models of the process, which often fail to include the elements of informal interaction that take place in parallel with more formal work [68, § 6].

As a mechanism of informal communication, email may provide an important source of information for analysing the design process (and other engineering processes) by identifying otherwise 'hidden patterns of collaboration and leadership' [61, p.133].

3.3. Discussion

Figure 3.1 is a set diagram showing a more complex picture of the relationships between the issues and opportunities identified and the categorisation used. It is also intended to give a more visual representation of distribution of issues and opportunities from the three domains across the categories.

The daily activities of a design engineer are essentially the same as any other knowledge worker. In the context of a tool for communication,email works as well and as badly for engineers as it does within wider industrial and commercial settings, therefore it is perhaps not surprising that engineering specific *user* issues have not been identified from the literature.

Section 3.2.1 focuses on the general user issues emerging from the CSCW and HCI communities. The issues that were identified can be seen (from Figure 3.1) to be concentrated in the User and Records categories. Many of the Records issues have considerable overlap with the Collaboration and Communication category. The Extended issues are split evenly between the Knowledge Creation and Collaboration and Communication categories. The Engineering issues are mainly concentrated in the categories of Records and Collaboration and Communication.

From this grouping three broad themes can be identified and can be seen as meta-issues that are significant to engineering:

[5]Communications with Industrial Partner

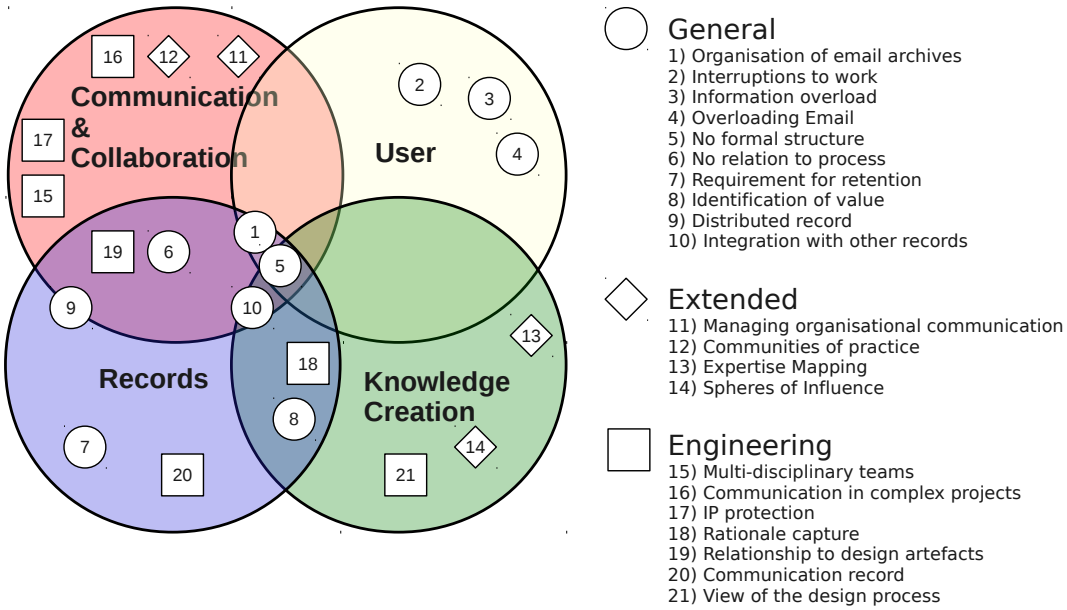


Figure 3.1.: A set diagram showing relationships between the issues and opportunities, and the categorisation used.

Context Many of the engineering issues highlighted in this review are bound by an underlying commonality, which is a lack of context. As described in the introduction, context is crucial to effective communication and to the producing of effective records of engineering work. Issues such as rationale representations (Issue 18) and the relationship to work processes (Issue 6) and design artefacts (Issue 19) can only be addressed by the addition of 'more' context to information. Related to this are issues such as the lack of formal structure in email (Issue 5), which when considering the records that can be produced (rather than short term utility), results in lower quality or at least less consistent, records.

Understanding Section 3.2.2 focuses on opportunities for the use of email in improving organisational practice and understanding. Email has been identified as providing access to otherwise 'hidden patterns of collaboration and leadership' [61, p.133]. Which has a direct bearing on the use of email for managing organisation communication (Issue 11), the identification of communities of practice (Issue 12) and understanding spheres of influence within the organisation (Issue 14). Such information would also provide a useful insight for engineering project managers, to help address issues such as poor communication within multi-disciplinary teams (Issue 15) and complex projects (Issue 16). Existing research in this area is limited to identifying communications bottle-necks and as a result optimising communication flow within organisations [61].

Behaviour A number of the issues identified are associated with users having difficulty using complex Information Systems and working environments. Users experience difficulties dealing with the sheer volume of information sent at them (Issue 3). In Chapter 2 the move to virtual working and increasingly interdisciplinary teams (§ 2.2.2) was highlighted. Issues 15 and 16 reinforce this by identifying the problems resulting from the way different users will express themselves and the difficulty in managing customer and partner relations in complex projects. In reaction to these pressures researchers have re-purposed simple tools such as email to provide the affordances of a myriad of discrete tools (Issue 4). However, such new tools have suffered from poor adoption and are unknown outside of academia, this seems to be partly due to the narrow focus such academic tools typically take. For such tools to be adopted in the engineering domain a broad and comprehensive understanding of engineers' practice and perception of email is needed.

Limitations

The issues are drawn from a subset of the academic literature, specifically, literature from the following communities was included in the review: computer science, linguistics, computer supported collaborative working, management and engineering. The choice of research communities was guided by a previous study (§ 3.1) on the different "different disciplinary fields regarding e-mail". Any literature review is necessarily incomplete, however, it is felt that the issues identified provide a strong foundation for the identification of the three underlying themes of Context, Understanding and Behaviour, which have been used to direct the exploratory studies conducted.

3.3.1. Summary

As argued in Chapter 1, a significant gap has been identified in research into the role of email in the engineering domain. This review has explored a cross-disciplinary

range of literature, synthesising a set of 21 issues that underlie "the email problem". Additionally, the 21 issues concisely express the current academic understanding, in a form that is digestable for process improvement in Industry and by other academics looking to improve the use of email in engineering.

The review has highlighted the range and importance of the issues and opportunities, the relationships between the issues and has argued that 3 uniting themes of Context, Behaviour and Understanding can be used to understand the issues.

The following chapter develops research questions based on the understanding developed through this review, and with reflection on the research methodology describes three investigative studies to explore the three themes, Context, Understanding and Behaviour, identified as underlying the issues synthesised in this literature review.

3.3.2. Contributions to knowledge

- 3 themes (§ 3.3) that can be used to understand, in broad terms, the issues identified.
- 21 issues and opportunities were identified by reading the literature and synthesising the key ideas that emerged; the issues and opportunities add detail to the research problem identified in the introduction and provide a useful summary of the literature for industrial researchers.

4. Methodology and research questions

The Introduction and Literature review outlined and then developed the need, context and rationale behind this research. The literature review concluded with the identification of 3 underlying themes: Context, Understanding and Behaviour that unite the issues identified.

The following sections in this chapter will describe the methodological approach used to conduct the research, the specific research questions, associated objectives and the specific methods used to address them.

4.1. Methodological approach

In their review of the state of engineering design research Blessing and Chakrabarti identified 3 issues that they aimed to address through the development of their Design Research Methodology [70, § 1.3]. The first issue they point to is the difficulty in achieving a good overview of the existing research on any topic within the engineering design research field. They go further in identifying the root of this difficulty in the pre-paradigmatic nature of engineering design research. This research reported in this thesis does not claim to establish a paradigm and therefore recognises the need to draw from a broad literature; taking in multiple engineering, computer science, information science and sociology domains to construct a comprehensive overview of the existing research in the area. This overview can then be used as a stage for the further investigative and prescriptive work.

The second issue identified was the "lack of use of results in practice", to address this the research was designed from the beginning with the application of any findings in mind. Concretely this took the form of integrating a validation trial (Chapter 10); but also holistically, from the instantiation of the project by a request from industry (Chapter 1) to the focus on an holistic approach to addressing the key problems.

The third issue was a need for "scientific rigour", to address which they propose their Design Research Methodology (DRM) a flexible approach which recognises and supports the fundamentally cross-disciplinary nature of engineering design research [70, § 1.4]. However, due to the cross-disciplinary and pre-paradigmatic nature of engineering design research, the best method to meet a particular objective is rarely explicit. As such in reporting on the research in this thesis the reasons for choosing methods will be discussed and the effectiveness of the methods in meeting the objective will also be reported.

The "DRM Framework" is designed to support the wide range of research that goes on within the field of engineering design research. Broadly it describes research in terms of 4 stages: Research Clarification, Descriptive Study I, Prescriptive Study and

Descriptive Study II[70, § 2.3]. From combinations of these stages the range of different types of research project are described with the type of project that is most appropriate being prescribed by the state of existing research in the problem space. As described in the introduction and the literature reviews (§s 2.4 & 3.3.1), there was little descriptive basis for the problem that this research sought to address. Therefore, the research was structured to have a strong emphasis on first providing a description of the (re)use of email as records in engineering. Upon completion of the descriptive studies, sufficient understanding was developed to design an intervention, and carry out initial prescriptive studies to assess its effectiveness. As such the project can be best considered what Blessing and Chakrabarti term a Type 2 project: a review based research clarification, followed by comprehensive descriptive studies and concluding with initial prescriptive studies (the detailed structure of the project is described provided in the following sections (§ 4.3).

Having set out the framework for the research, the following section introduces the research questions that will drive each stage of the project.

4.2. Research questions

The following research questions are targeted at the gaps in current understanding identified through the literature reviews and at developing a proposal for a practical intervention to improve email use in engineering. The first three questions aim to develop an understanding of email, and the second two questions aim to use that understanding to improve the (re)use of emails.

The first 3 questions are directly driven by the identification, through the literature review, of 3 underlying issues Context, Behaviour and Understanding (§ 3.3), respectively:

1. What information is present in emails?
2. What are engineers' perceptions of email as a system and how do they use it?
3. How can email be used beyond its role as a communication system?
4. What are the requirements for an email system that supports the (re)use of email as records?
5. How can email, as currently conceived, be improved and evaluated in this regard?

4.3. Research structure

To answer these research questions, 3 investigative studies (Part II), a set of requirements (Chapter 9) and an experiment to study an intervention to meet the key unmet requirement (Chapter 10), are presented in the subsequent chapters:

4.3.1. Question 1

Chapter 6 discusses an analysis of a corpus of emails and this answers Question 1 by showing what information is present.

4.3.2. Question 2

Chapter 7 presents the results of an on-line survey to answer Question 2 by asking about perceptions and use of email.

4.3.3. Question 3

Chapter 8 presents an investigation of how email can be used to visualise the interconnections within a company generated by email usage; this answers Question 3 by illustrating a usage for email (other than as communication).

4.3.4. Question 4

From the investigative studies, and from interviews with engineers, a list of 7 requirements for email to support reuse are identified in Chapter 9 to answer Question 4.

4.3.5. Question 5

Chapter 9 highlights those requirements that can already be met; Chapter 10 shows how the provision of contextual information can help a new reader to understand old e-mail, and this shows one way for improving email for reuse as in Question 5.

Part II.

Investigation

5. Experimental data

This chapter introduces the data set used for the three investigations described in Chapters 6 to 8. The data set was provided by the Industrial Partner for this research. The data set consisted of an email corpus (from a single engineering project) that comprises over 16 000 email (§ 5.1), the associated project documentation and the opportunity to interview 6 engineers (§ 5.2) involved with the project.

The data set contains information pertaining to a single engineering project which was centred around a series of 6 high value ship-building contracts. The Company acted as a major supplier for a large foreign industrial company (referred to as the Customer). Each contract essentially required a replica of the work in the first, tailored to the varying requirements of the end users (referred to as the User). During the course of the project the Company acted primarily as an integrator negotiating with multiple suppliers (referred to as Suppliers), providing a number of large sub-systems for the ships.

5.1. Corpus

The corpus consists of 16 000 email sent over the first 4 years of the project. The corpus represents the email exchanges of 650 senders (1 080 recipients), with approximately 30 of those being core project members (either from within the Company or the Customer). The email were selected by employees, who either authored the email within an internal project information management system, or copied email from their individual email accounts into the system.

Entry of email into this management application was explicitly managed and encouraged by the Project Director, who also handled the organisation of documents within the project information system.

The selective process of adding emails to the corpus, limits how representative it is of typical engineering email corpora and its comparability with corpora from other companies, however the selection process also proved essential in allowing the email exchanges to be analysed in the context of a single project. Having a project specific dataset allowed the content of the email to be compared to information obtained from the project documentation, for example.

5.2. Interviews

A set of 6 interviews with the key engineers within the Project were carried out. The interviews fulfilled a number of roles. The understanding of the project gained from the interviews was used to provide additional context for and enable the assessment of the results of the automated analysis. The transcripts of the interviews are provided in Appendix B.

The interviews were conducted by the author and another researcher, both with recently obtained Mechanical Engineering degrees. The interviews were carried out at the Company site, they were semi-structured in nature and lasting for at least 30 minutes each. The interviews were recorded, the recordings were transcribed and findings were elicited and are discussed later in this chapter.

The interviewees were selected to provide broad coverage of the roles within the project. This was to produce a representative view of the different roles within the project rather than to produce a proportional sample across the project. As a result the findings cannot be generalised, they only represent the opinions and perceptions of the interviewees. All of the engineers were still involved with the project in the same capacity, although only 3 were still spending significant time on the project.

5.2.1. Roles

The following describes the roles of the interviewees:

Project Director

The principal managerial role in the project. Coordinated the Project managers and handled liaising with the Customer.

Project Manager

Managed the engineering team at the UK site, responsible for several major components of the project.

Project Secretary

Joined the project to act as logistical support when organising interactions with Suppliers and the Customer.

Service Engineer

Handled in service issues reported by the Customer and the User.

Warranty Manager

Investigated claims made by the Customer and determine contractual liability and negotiate responsibility and costs attributed to different parties with the Project. He had significant interaction with the Customer and the User.

Software Engineer

One of the engineers working under the Project Manager. He had only minimal interaction with Suppliers and no interaction with the Customer. This was his first project within this department of the Company, so he was 'trying to learn [the] systems and tools [and] work on [the Project]'.

5.2.2. Discussion

This section describes the main features of email use in the Company that emerged from the interviews. Further use of insights from these interviews is made in Chapter 9.

The Project Director revealed that the problem of knowledge churn (§ 2.2.2) was significant in the project, with "almost every name chang[ing] apart from mine" (§ B.1@13:29). The impact of this problem can be seen if related it to the 3 interviewees mentioning that when information seeking they commonly rely on other engineers' understanding

of the existence and location of the information they are looking for, rather than using technical retrievals mechanisms (§s B.3@25:34, B.6@15:15, B.5@15:13,22:15).

The primary affordance of email was consistently described as being its role as a record keeper, both in the sense of keeping incidental records of ongoing communications and also for specific and intentional recording of key points. (§ B.6@02:14, B.4@33:32, B.3@01:23, B.5@02:46)

The Service Engineer described how managing the information flow resulting from regular activities such as filing field reports was difficult and was not something that was easily supported by email (§ B.5@47:00).

Another affordance mentioned was that of providing a clear communications channel when clarity is critical or the recipient is a non-native speaker (§ B.5@05:27). Although it was also mentioned that there are cultural differences in terms of the expected sending and response behaviours when communicating with engineers in a different nation (§ B.2, p.126).

5.3. Summary

The repeated mentioning of the use of people when finding information inspired an investigation to explore how such human driven information seeking could be made more effective using the contextual information already available in the corpora of email – see Chapter 8.

The references to email as record keeping system support the general view of this report, that email is an important communication and information management system in the modern engineering environment.

The remaining chapters in this part of the report go onto describe 3 investigative studies that explore different aspects of email in engineering.

6. Email Content

The review of the literature (Chapter 3) identified contextual information and the structuring of information in email as two underlying factors in many of the issues identified (§ 3.3). To aid understanding of the information currently embodied in engineering email an investigation to determine the characteristics of the content of the email was undertaken. The investigation was carried out using the corpus of email provided by the Industrial Partner (Chapter 5).

6.1. Coding schema

This investigation used a coding schema to mark-up a corpus of email, in order to determine the overall characteristics of the email corpus. The investigation used a coding schema developed by Wasiak et al. [71]. The schema is grounded in the literature and has been developed and validated to effectively characterise the content of email.

The schema is split into 3 sets of codes, each answering a different question: What, Why and How. These code sets are further sub-divided into a 2 level hierarchy of codes and sub-codes, to allow for more detailed coding. At the sub-code level the level of scope and abstraction is variable. Codes and sub-codes can be considered as tags; used in combination to describe a particular email or an information fragment within an email.

Tables 6.1 and 6.2 provide the codes and sub-codes, and their descriptions, for the What and Why code sets of the schema, respectively. Tables 6.3 and 6.4 provide the socio-emotional and the task related codes, and their definitions, which make up the How code set of the schema.

The What codes are used to describe the topic which a particular email, or section of an email relates to. The Why codes are used to describe the purpose for a particular email being sent. The How codes are used to describe how the author expressed the content of the message.

The coding was carried out using all the contextual information available to the coders[1], including the body of the email, the subject, knowledge of the sender and recipient from previous email or the domain name of their email address. The coders also had some knowledge of the roles of specific individuals within the project drawn from interviews and the project documentation. The coders interpreted the schema and content of an email objectively, but it was necessary to infer the meaning of some email. The consistency and reliability of the coders' interpretations were assessed statistically (§ 6.3).

[1] The author & Wasiak

Product The output of the project	**Project** The domain within which the product is created	**Company** The sponsors or facilitators of a project
Functions Things the product must do e.g. be fast	**Risk** Assessing likelihood and weighing implications	**Financial Resources** Cash, Assets, Borrowing.
Performance How well the product achieves its functions.	**Plans** Management of phases, activities and tasks.	**Economic Issues** Costs and efficiency, market and product selection
Feature The quality or characteristic with which the function is achieved.	**Team** Team selection, development.	**Human Resources** People, availability, allocation, training, replacing.
Ergonomics User Interaction with product.	**Quality Management** Quality, standard or expectations.	**Physical Resources** Ranging from offices to equipment.
Materials & Components Materials and component selection and characteristics.	**Cost** Financial arrangements at project level, rather than specific component costs.	**Stake Holders** Such as shareholders and customers, and their culture and politics.
Manufacturing Consideration of manufacturing, assembly and transport.	**Time** Durations or deadlines. Any link or reference to time.	**Knowledge Resources** Current ability and stored information.
Cost Consideration of costs particularly unit costs.	**Delivery** The delivery or provision of a specific component or sub-system.	**Tools & Methods** Specific testing and modelling techniques.
Operating Environment Objects that interact with the product.	**Manufacture** Arranging manufacture, planning manufacture, in the context of the project.	**Practices & Procedures** Accumulated by the company, often developed through experience.
Specification Requirements of the product/design. Or requirements for components of the product.	**Contracts** Legal arrangements involving two or more parties setting out what is required from the project.	
	Milestones & Deliverables Targets to be achieved, or which have been achieved, related to stages within the project.	
	Knowledge Resources Reference to general documentation resource, or mention of Knowledge Management process specific to the project.	
	Administration General administration related to the project, but not distinctly captured by one of the other codes above.	

Table 6.1.: The codes and sub-codes within the What code set, and their definitions (Source: [43])

Problem Solving	Transactions
Goal Setting Identifying where the design is, and where it needs progressing to.	**Informing** Sharing, presenting or distribution information with others. No response is required.
Constraining Imposing boundaries with requirements and desirables.	**Clarifying** Clearing up misunderstandings (both requesting and in response). Asking for explanations, resolving a general lack of clarity.
Developing Solutions It may encompass one or more of the following stages: searching, gathering, creating and developing solutions. Presentation of solutions for comment is also encompassed.	**Managing** Includes arranging, directing and instructing. Implies action (such as a response) needs to be taken. Including process management outside of the organisation, e.g. prompting arrangements / meetings with third parties.
Evaluating Judging the quality, value and importance of something.	**Confirming** Confirming or requesting confirmation of something.
Decision Making Considering key factors from evaluation and possible compromises to form decision.	**Requesting Information** Direct request for someone to provide information. Including explicit responses to requests for information.
Reflecting Reflecting upon a design/product decision or process already adopted or occurred. Reflecting may question whether a new of further problem now exists.	

Table 6.2.: The codes and sub-codes, within the Why code set, and their definitions (Source: [43])

Positive	Negative
Shows Solidarity raises others status, gives help, reward.	**Shows Antagonism** deflates others status, asserts or defends self.
Shows Tension Release jokes, laughs, shows satisfaction.	**Shows Tension** asks for help, withdraws out of field.
Agrees shows passive acceptance, understands, concurs, complies.	**Disagrees** shows passive rejection, formality, withholds resources.

Table 6.3.: The socio-emotional codes within the How code set, and their definitions (Source: [43])

Sharing	Requesting
Gives Opinion evaluation, analysis, expresses feeling or wish.	**Asks for Opinion** evaluation, analysis, expression or feeling.
Gives Suggestion direction, implying autonomy for other.	**Asks for Suggestion** direction, possible ways of action.
Gives Orientation information, repeats, clarifies.	**Asks for Orientation** information, repetition and confirmation.

Table 6.4.: The Task related codes within the How code set, and their definitions (Source: [43])

6.2. Methodology

For reasons of data security all the data collection activities took place on the main UK site of the industrial partner.

Two researchers coded a total of 800 email. The email were sampled from across the time-span of the corpus, with the samples coded by each researcher interleaved to reduce the effect of coder bias when analysing the corpus across the time-span. For the purposes of assessing inter-coder reliability 60 of the 800 email were coded by both coders. Calibration coding was also conducted at the beginning of each day to maintain consistency by mitigating against the coders independently establishing set behaviours when coding. The coding took place over a 4 week period, an average of 5 minutes being spent coding each email, with the remaining time being spent organising and processing the email, interviewing the engineers and having cups of tea. The coders used NVivo, a qualitative data analysis program, to facilitate the coding of the email [72].

Using the schema described (§ 6.1), the What and Why terminology sets were coded for across the whole sample of email. The How terminology set was applied to a much smaller subset of the sample (60 email), because the How set was significantly more time-consuming to code than the other sets and expending time on that set would have greatly reduced the size sample that could be covered by the more relevant What and Why sets.

6.3. Coding validation

Before reporting the results, it is worth reviewing the reliability of the two coders, using the validation sample.

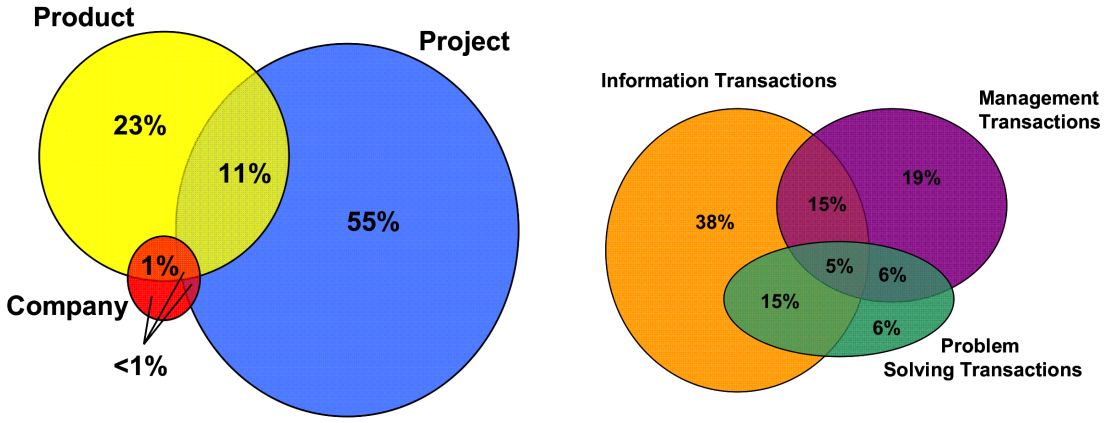
6.3.1. Inter-coder reliability

A statistical measure, Cohen's κ [73], was used to calculate the level of agreement between the two coders. The coefficient compares (Equation 6.1) the observed agreement ($Pr(a)$) between two coders with the hypothetical probability of chance agreement ($Pr(e)$). $\kappa = 1$ indicates complete agreement between the two coders. This measure was calculated separately for each of the codes, and the results for the top level codes (Table 6.5) show that suitable values of > 0.7 were achieved consistently.

$$\kappa = \frac{Pr\,(a) - Pr\,(e)}{1 - Pr\,(e)} \tag{6.1}$$

Code	Cohen's κ
Product	0.87
Project	0.85
Company	0.81
Information Transactions	0.82
Management Transactions	0.76
Problem Solving Transactions	0.71

Table 6.5.: Cohen's κ coefficient values for the top level codes.



(a) What (b) Why

Figure 6.1.: Venn diagrams showing the proportion of email coded with codes under the *What* and *Why* code sets. (Source: [43])

6.4. Results

The results of the coding of the email corpus are now presented, and they are discussed in section (§ 6.5). First the frequency of occurrence of the different codes and their combinations will be presented (§ 6.4.1). Then the variation in coding for different individuals within the corpus will be presented (§ 6.4.2). Finally the variation in coding over the time-span of the project will be presented (§ 6.4.3).

6.4.1. Occurrences

Having coded the email, the first and most intuitive approach to analysing the resulting data is to examine the frequency of code occurrence across the whole sample.

What

68 % of the email coded (and by extension in the corpus) related to the *Project*; 23 % to the *Product* and 4 % of the email related to the *Company*. 11 % of email were coded as containing elements of both *Product* and *Project* (Figure 6.1(a)).

Figures 6.2, 6.3 and 6.4 present the proportion of occurrence for each of the sub-codes within the *Project*, *Product* and *Company* codes, respectively.

Within the *Project* code (Figure 6.2): at 25 % the most prevalent sub-code was *Administration*, 16 % including elements associated with time. The predominant sub-codes

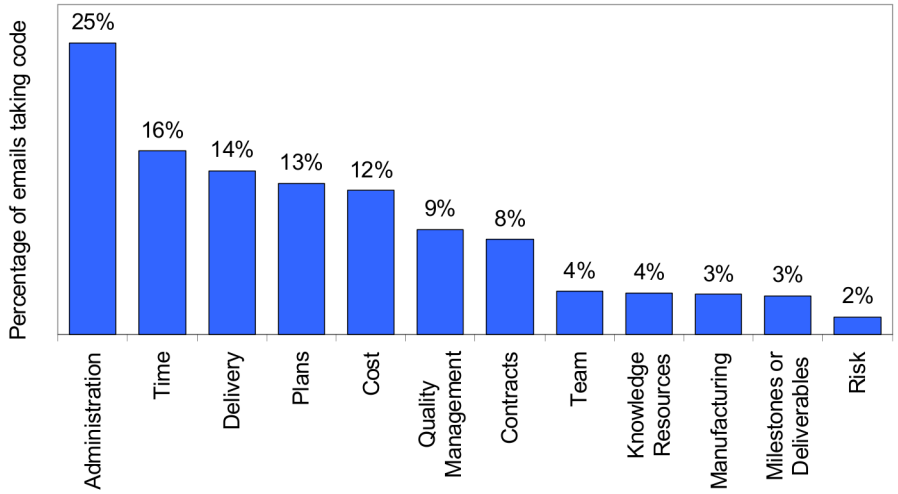


Figure 6.2.: Proportion of email coded for each of the different Project sub-codes. (Source: [43])

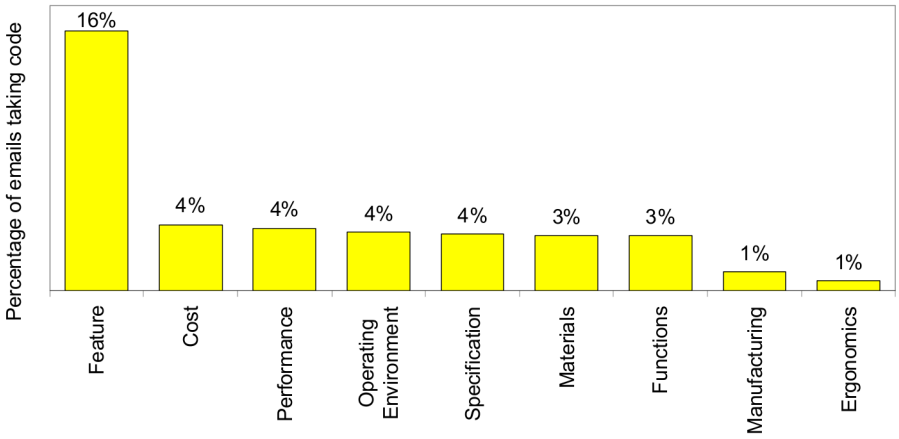


Figure 6.3.: Proportion of email coded for each of the different *Product* sub-codes. (Source: [43])

are *Administration*, *Time*, *Delivery*, *Plans* and *Cost*, and these are all closely associated with the primary roles of the industrial partner within the project, which was that of integrating components from a number of suppliers to produce a major sub-system of a large project.

Within the *Product* code (Figure 6.3): 16 % of email included *Feature*, whereas significantly lower proportions included the other sub-codes; the next highest sub-codes (*Cost*, *Performance*, *Operating Environment* and *Specification*) being at 4 %. It should be noted here that the definition of *Feature* was more abstract than its sibling sub-codes. For example, an email might contain several information fragments discussing a feature, of which, one information fragment explicitly discusses the cost implications of making a change to the feature.

Given the relatively low frequency of occurrence of the *Company* code, naturally all sub-codes (Figure 6.4) are even more infrequent relative to the sub-codes under *Product*

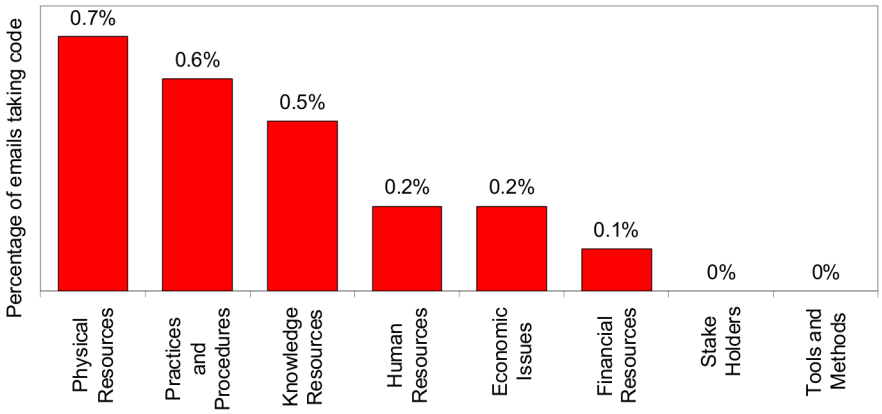


Figure 6.4.: Proportion of email coded for each of the different *Company* sub-codes. (Source: [43])

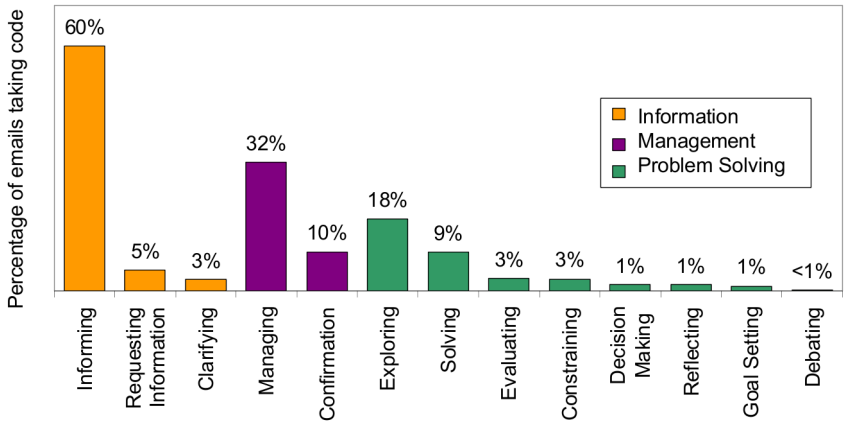


Figure 6.5.: Proportion of email coded with each of the sub-codes with the *Why* code set. (Source: [43])

and *Project*.

Why

73 % of the email coded (and by extension in the corpus) related to *Information Transactions* (the explicit sharing of existing information between two individuals, excluding information 'generating' activities); 32 % were sent for the purposes of *Problem Solving* and 45 % for the purposes of *Management* (telling someone to do something). A large proportion (38 %) were sent just for the purpose of requesting or providing an existing information object (Figure 6.1(b)).

Of the sub-codes which make up the top-level codes in the *Why* code set, the three most prevalent are: *Informing* (60 %), *Managing* (38 %) and *Exploring* (18 %). *Requesting Information* (5 %) occurs much less frequently than the provision of information (Figure 6.5).

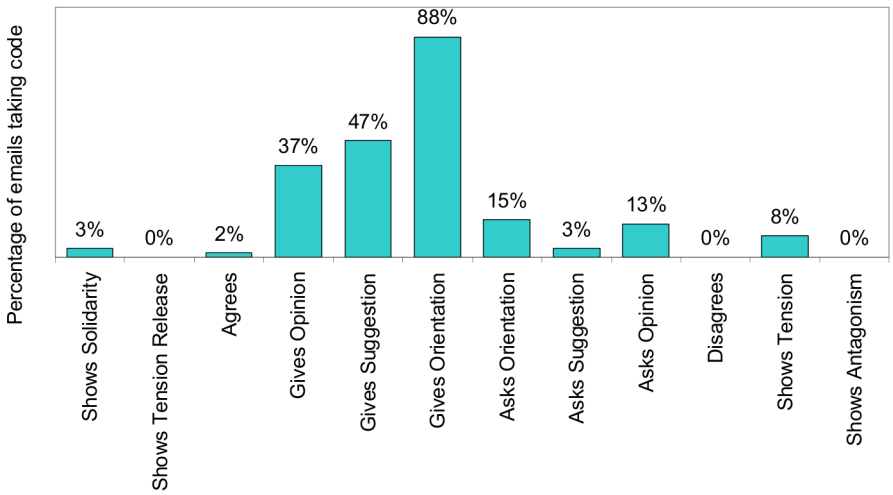


Figure 6.6.: Proportion of email coded with each of the sub-codes within the *How* code set. (Source: [43])

How

As previously mentioned, due to time constraints coding using the *How* code set was limited to a sub-sample of 60 email. The *How* code set deals with the coding of the manner in which the author expressed themselves, as such the granularity of coding required is much finer: each phrase within an email is coded. For the presentation of the results, the frequency of occurrence (as with the previous results) is aggregated to the email level.

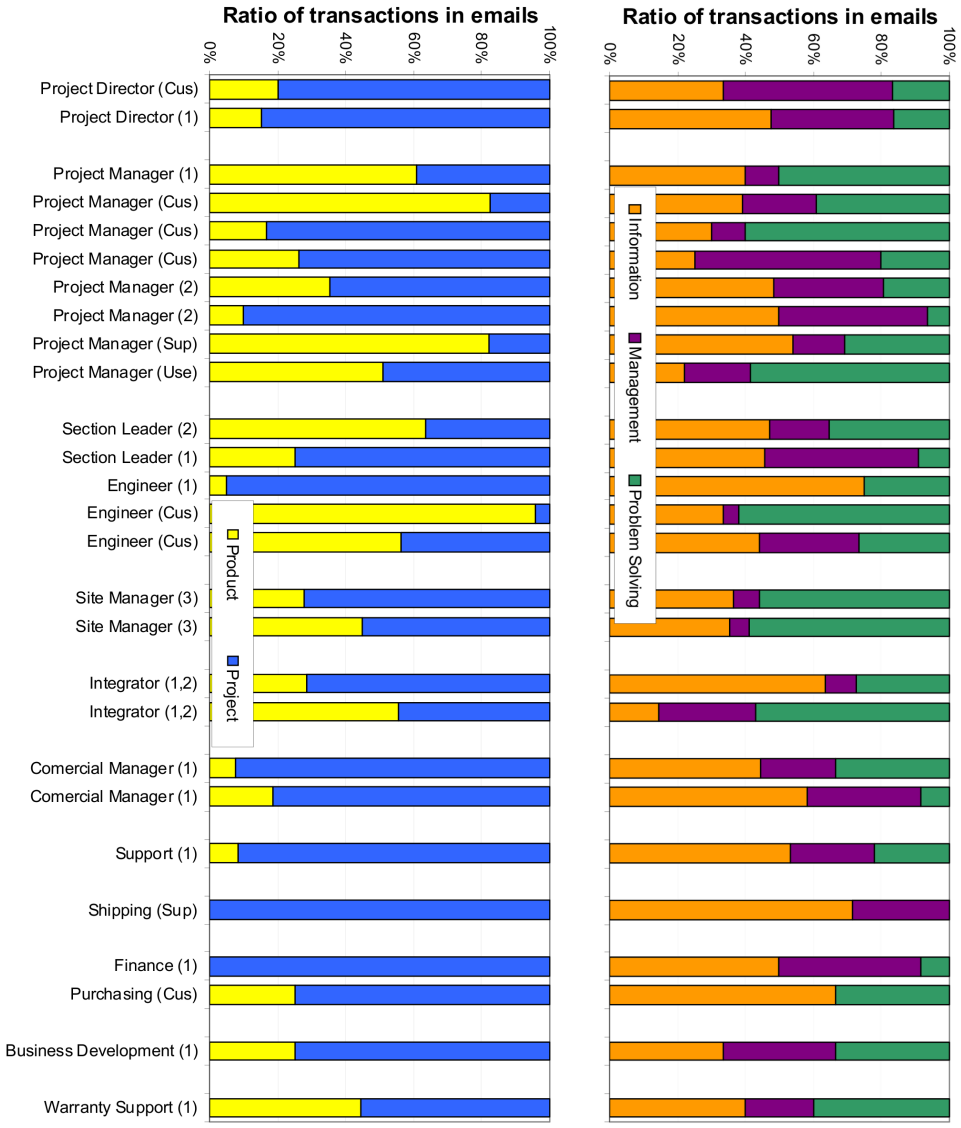
Figure 6.6 shows the three most prevalent sub-codes used were: *Giving Orientation* (88 %), *Giving Suggestion* (47 %) and *Giving Opinion* (37 %). Interestingly, the most negative emotional codes, *Disagrees* and *Shows Antagonism* were not present within the sample - although given the small sample it would be inappropriate to extrapolate from these results and state that the corpus did not contain these codes.

6.4.2. Individuals

Having presented the frequency of occurrence of the codes, data on the authors of the email will be used to explore the relationship between individual roles or styles and the characteristics of their email. Of the 670 individuals in the project, 27 sent sufficient email for meaningful results to be presented.

Figure 6.7(a) presents the relative proportion of *Product* and *Project* email sent by each of the 27 individuals. The individuals are grouped by role. It is clear that when examining what topic an email is associated with, roles are not a good, or consistent, distinguishing characteristic; many individuals from the same company who share the same role are seen to have significantly different proportions of their communication relating to *Product* and *Project*. It should of course be noted that the role definitions used, are abstract and as such may not characterise the actual work undertaken by the individuals. Having said that, non-engineering roles, such as project support and commercial management roles can be seen to send little or no *Product* coded email.

Figure 6.7(b) presents the relative proportion of email coded with *Information Trans-*



(a) What (b) Why

Figure 6.7.: The relative proportion of codes in the *What* and *Why* code sets email sent by the 27 most prolific individuals in the sample. (Source: [43])

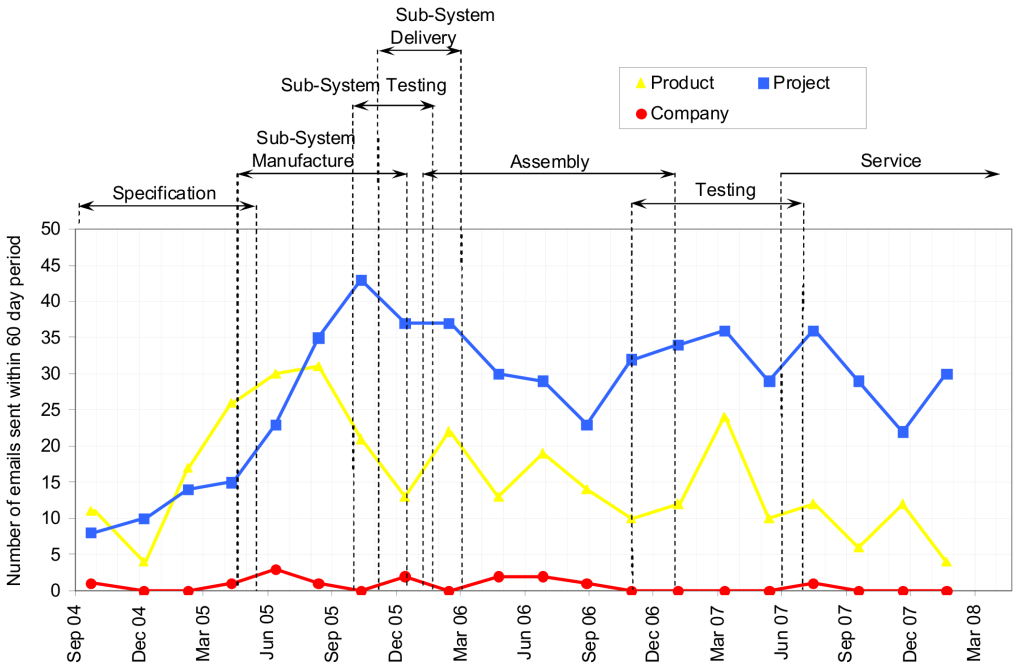


Figure 6.8.: Variation in frequency of code occurrence with time for the *Product*, *Project* and *Company* codes. The variation is plotted with a 2 month resolution. The phases of the project are overlaid to aid comprehension. (Source: [43])

action, *Management Transaction* and *Problem Solving Transaction*, for each of the 27 individuals. The individuals are grouped by role. As with the for the *Product* and *Project* codes, roles do not seem to be a good distinguishing characteristic.

6.4.3. Time-span

This section presents time-variant trends in the codes of, first, *What* (§ 6.4.3) topic email are about, followed by *Why* (§ 6.4.3) they are sent.

What

Figure 6.8 presents the variation in the frequency of code occurrence with time for the top-level codes in the What code set. As was indicated in previous sections the proportion of email coded with *Company* was significantly lower relative to *Project* and *Product* codes. Across the span of the project email related to the *Company* seem to be consistently low, with no significant periods of activity.

The Specification phase sees an increase in the number of email sent relating to the *Product*. At the end of the Specification phase, the number of *Project* related email increases rapidly as the Sub-system Manufacture phase begins, peaking at the beginning of the Sub-system Testing phase, and just proceeding the Sub-system Delivery phase. Whilst the *Project* related email are increasing, the *Product* related email are levelling out, and then falling significantly. *Product* related email continue to fall (with isolated peaks) for the remainder of the time-span.

There is a peak of *Product* related email in the middle of the testing period. From interviews we have ascertained that this peak coincided with a particularly intensive

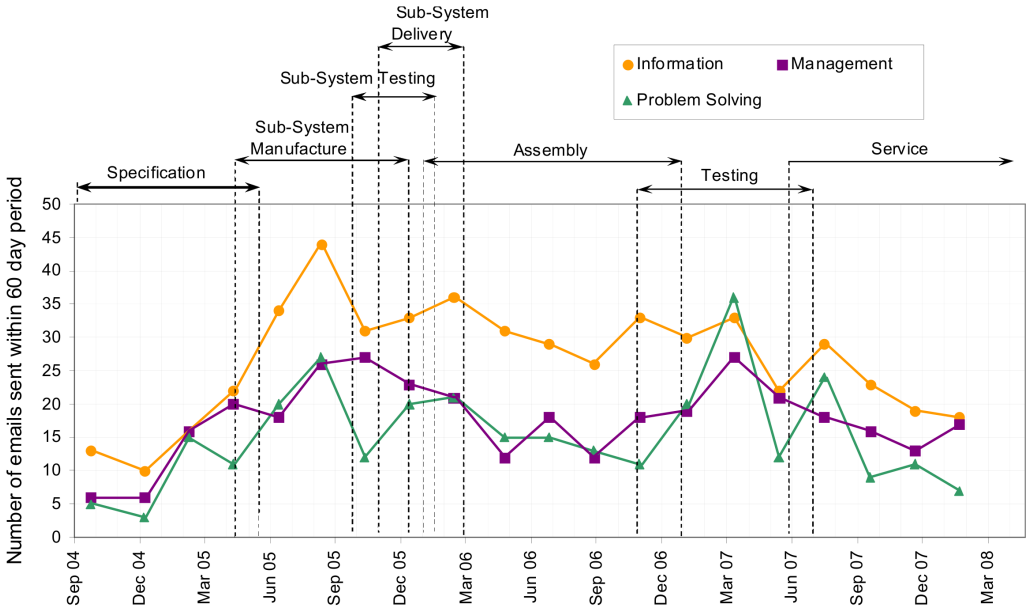


Figure 6.9.: Variation in frequency of code occurrence with time for the *Information Transaction*, *Management Transaction* and *Problem Solving Transaction* codes. (Source: [43])

series of tests which were carried out at the Customers site, which was separated by several time-zones from the main engineering team.

Why

Figure 6.9 presents the variation in the frequency of code occurrence with time for the top-level codes in the *Why* code set.

As was shown previously, *Information Transaction* is the most prevalent purpose for sending email. It is the most prevalent purpose across the span of the project, with the brief exception of the peak associated with the testing period, at which time *Problem Solving* narrowly becomes the primary purpose. This corresponds well with the previously identified peak in *Product* related email, and insights from the engineers from the industrial partner which suggested this was an intense period of testing and fault-finding (§ 5.2).

6.5. Discussion

The great majority of emails related to the project. Within the project grouping, were included aspects of time, delivery, planning and administration. As this engineering project was a complex integrative activity, involving the industrial partner in the UK organising the delivery of large systems from multiple suppliers it is perhaps to be expected that logistical activities form a significant part of the corpus.

A relatively small number (4 %, #640) of emails related to the Company. As previously described (Chapter 5) the corpus was provided from a project specific information management system, and as such only contains the emails relating to the project in question. This may have resulted in some emails which strongly related to Company not being added to the corpus.

2 % (#320) of emails were coded with *Project Risk*. These emails, in dealing with identified risks to the project, are crucial to the success (or effective performance) of the project and would be of significant learning and reuse value to the industrial partner.

A review of the documentation associated with the project and a consultation with the Project Director during a review of the findings, identified that much of the information discussing risks to the project and problem solving was not present in the formal documentation of the project.

Just 1 % (#160) of emails mention manufacturing. However, given the role of the industrial partner was that of a system integrator, perhaps it is not surprising that this number is low. The same reasoning applies to the small number of email relating to ergonomics.

That 38 % of emails were sent exclusively for the purposes of exchanging existing information objects, would indicate a significant under performance in the explicit document management practices of the industrial partner and/or its engineers.

The plots of the variation in the frequency of occurrence of *What* and *Why* codes set over the time-span (Figures 6.8 & 6.9) of the project show that the make-up of the corpus in codes of both topic and purpose vary significantly with time. Particular features of the variation in code occurrence can be related to events identified through the project documentation and interviews with engineers. This might be further generalised to suggest that variations can and do reflect changing activities within a project.

The researchers carrying out the coding often experienced difficulty when attempting to interpret the content of the emails. Both coders involved had been educated as engineers, and most of the difficulty resulted from ambiguity or project/company specific terminology, rather than general engineering terminology.

The industrial partner uses a system to manage project information through which emails are associated with particular projects. Without that association most of the email would not have been distinguishable from those of other projects, or intelligible from the perspective of long-term reuse.

6.5.1. Limitations

It should be noted that it can be misleading to directly compare the proportions of sub-codes occurring within the corpus as each sub-code is not equivalent in its scope or level of abstraction. For example, the sub-codes *What*→*Product*→*Feature* and *What*→*Product*→*Cost*, although siblings, the first codes for "properties of the product" and the second codes for "considerations relating to cost with regard to any aspect of the product", including perhaps, costs associated with the introduction of a feature.

6.6. Summary

The aim of this investigation was to aid the understanding of the information content of emails.

This investigation has confirmed that email contain information that is potentially valuable for medium and long term reuse, information such as the identification of risk and the discussions for the purpose of problem solving. This information is, however, not explicitly represented within the email, in the sense of being part of an explicit problem solving exercise recognised by the participants, and with regard to the project studied, was not recorded in other project documentation.

The experience of the coders in interpreting the content of the email in the corpus highlights a wider problem engineers have when trying to interpret information from projects or organisations that they are not familiar with. Specifically this is the result of a lack of contextual information and consistent (and defined) terminology. This problem was identified in review of issues and opportunities (§ 3.3).

6.7. Contributions to knowledge

- Presented a detailed description of the content of emails from a real engineering project which is of use to future researchers in understanding email content.
- Identified that the email corpus contains valuable information, for example, 320 (2 %) emails with information about risks to the project (§ 6.4.1).
- Found that valuable information about risks and problem solving within emails was not present within other project documentation. (§ 6.5)

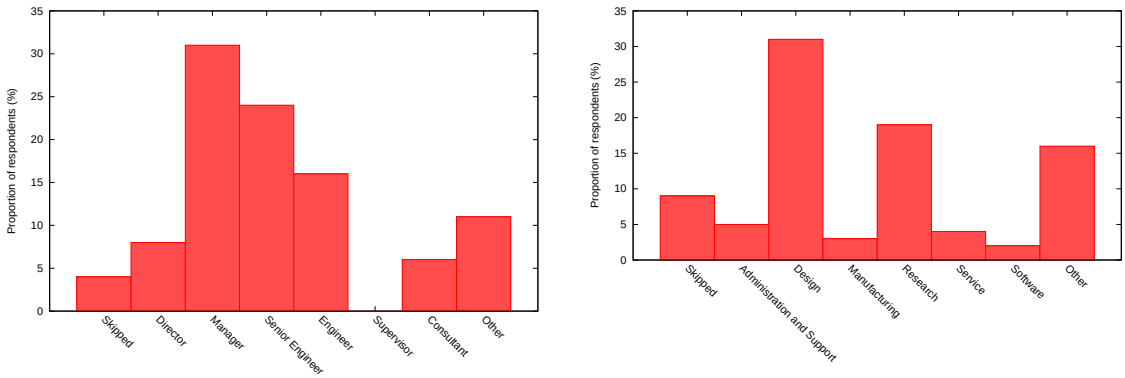
7. Survey

The literature review (Chapter 3) identified behaviour as being 1 of 3 themes that issues, relevant to engineering, fall into. Behaviour relates to the way engineers use and cope with using email and how they perceive it. An on-line survey was conducted with the aim of better understanding the practice and perception of email within the engineering profession.

The survey took a broad sample to understand the extent of email use within the engineering industry. The primary objective of the survey was to investigate the relationships between the distribution of teams, the mechanisms they use for communication within and beyond their teams and the particular activities they use email for. The questions in the survey can be found in Appendix A; with the questions being presented to participants through a simple, single page, web interface, with the answers being stored in a relational database.

Invitations to participate in the survey were distributed by email, through contacts in the Industrial Partner company, a large aerospace engineering firm, and to IMechE and IET mailing lists. There were 89 respondents to the survey. Of these respondents ∼45 % reported their affiliation, indicating that the survey has reached at least 15 engineering companies. The sample covered a range of roles and areas of expertise, the dominant role and area being Managers (36 %) and Design staff (35 %), respectively (see Figure 7.1).

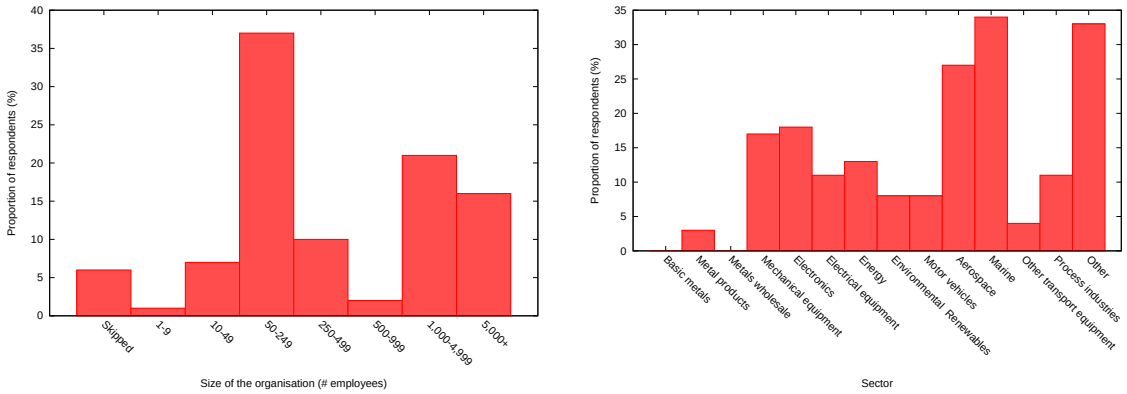
The respondents were asked about the size and sector of the company they represent (Figure 7.2). For sector, within the 'Other' response the largest was Defence with 6 % (of all responses). From the responses it can be seen that although the survey does span the range of sizes and sectors there are significant differences in distribution. There will thus be a bias towards larger companies and towards the Marine and Aerospace



(a) Roles

(b) Working areas

Figure 7.1.: The roles and working areas (respectively) of the survey respondents.



(a) Size (b) Sector

Figure 7.2.: The size and sector (respectively) of the companies which the survey respondents represent.

sectors. It is likely that these biases are the result of the contact pool used for the distribution of the questionnaire.

7.1. Objectives

The specific objectives which the survey is aiming to address are as follows:

1. Understand the perception of the role of email within engineering firms (in combination with interviews (Chapter 5)).
2. Understand the approaches engineers (and their organisations) are currently taking to manage their email records.
3. Highlight particular activities which require the most support from a system designed to improve the quality of record keeping, with respect to the use of electronic communication methods.

7.2. Results

The results are presented with respect to the objectives (§ 7.1):

Role and area

Question 1 provides the roles and the professional areas of the respondent. See Figure 7.1 for plots of the results. The Manager, Senior Engineer and Engineer roles, and the Design, Research and Other areas have the highest representation amongst the respondents respectively.

Age

Question 2 asked what age group the respondent belonged to. See Figure 7.3 for a plot of the result.

Time using Computers and email

Questions 3 and 4 asked the respondent how long he spent each day using a computer and email (including reading, writing and organising), respectively. See Figure 7.4 for a plot for the results. From the plot we can see that over 50 % of engineers spend

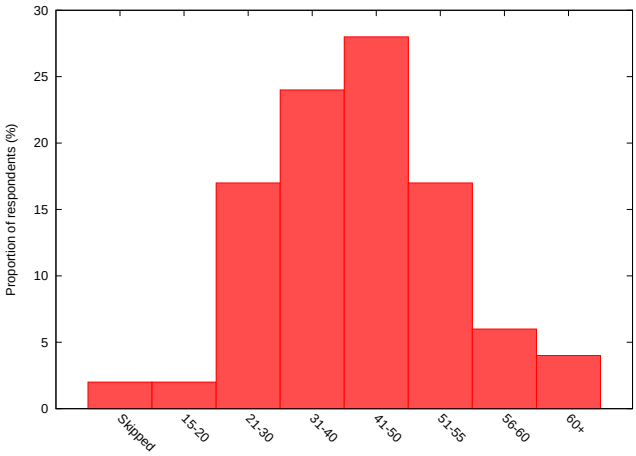


Figure 7.3.: The proportion of respondents belonging to each age range.

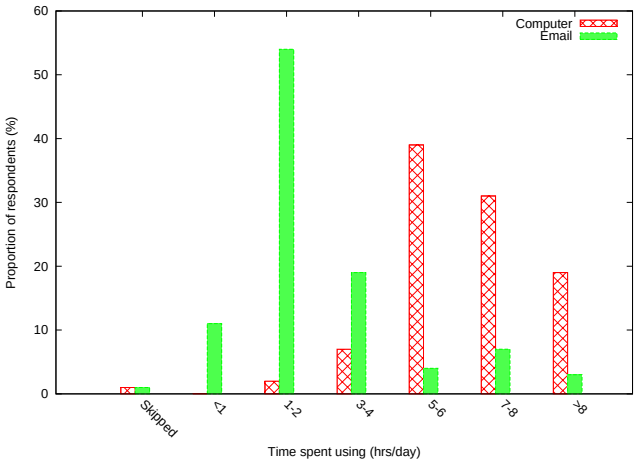


Figure 7.4.: The time respondents spend on using their computer and email in terms of the proportion of respondents in each band.

at least 1 hour a day (12.5 %) reading, writing and organising their email. 10 % of engineers report that they spend at least 7 hours using email.

Organisation size

Question 5 asked for the approximate size of the respondent's organisation. See Figure 7.2(a) for a plot of the results. The highest return was for organisations of 50 to 249 employees (37 %). 13 % of respondents worked for organisations with over 1 000 employees.

Sector

Question 6 asked what sectors the respondent's organisation worked in. See Figure 7.2(b) for a plot of the results. The dominant sectors in the report were Marine (34 %), Other (33 %) and Aerospace (27 %). The sectors respondents is heavily biased by the contact and information distribution networks available to the authors research establishment and therefore the over dominance of particular sectors can not be taken to be significant.

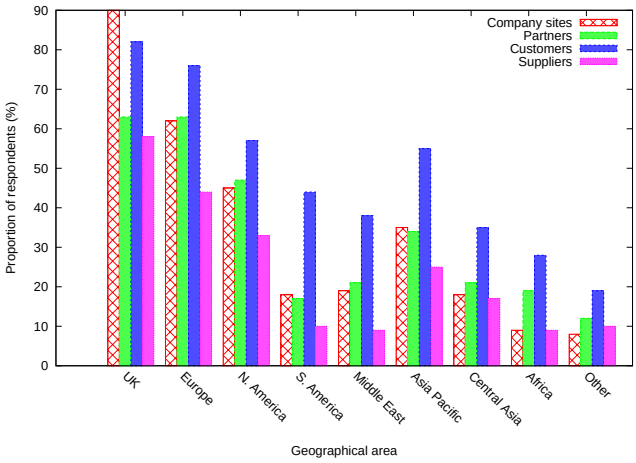


Figure 7.5.: The proportion of respondents whose organisation has sites, partners, customers and suppliers in different geographical regions.

Global distribution

Question 7 asked the respondent to indicate in which regions of the world his organisation had sites, partners, customers and suppliers. See Figure 7.5 for a plot of the results. The results show that the survey has reached organisations with a truly international presence. For each of the 4 measures: Company sites, Partners, Customers and Suppliers, not unsurprisingly, the top 4 regions were the UK, Europe, North America and Asia Pacific, respectively.

How do they work?

Question 8 asked the respondents about the ways in which they work, in the sense of what kind of teams are they a part of or do they work alone. The responses to this question were used to tailor the options in Questions 10 and 15. See Figure 7.6 for a plot of the results. The majority (55 %) of respondents work as part of a co-located team, with a slightly lower number (48 %) working individually – this was a multi-select question, so overlap was expected. Interestingly, the least prevalent working arrangement was the 'International internal team' at 17 % compared with 'International multi-organisational team' at 33 %.

Typical life of a team

Question 9 asked how long a typical team in the respondent's organisation lasted for. See Figure 7.7 for a plot of the results. 40 % of respondents reported the teams they work within typically last 'Years', although with 27 % reporting they typically lasted months. Team life impacts on the level of trust and familiarity between individual members that in turn affects the communication mechanisms that they might choose to use [44]. The survey did not ask how long the projects typically last, which may have been a useful point of comparison.

Communication mechanisms

Question 10 asked the respondent to indicate the regularity with which they used each of the listed communication mechanisms for each of the different types of team they worked within (see Question 8). The results are presented in Table 7.1, The results from this question are discussed in detail later in the chapter (§7.3.1).

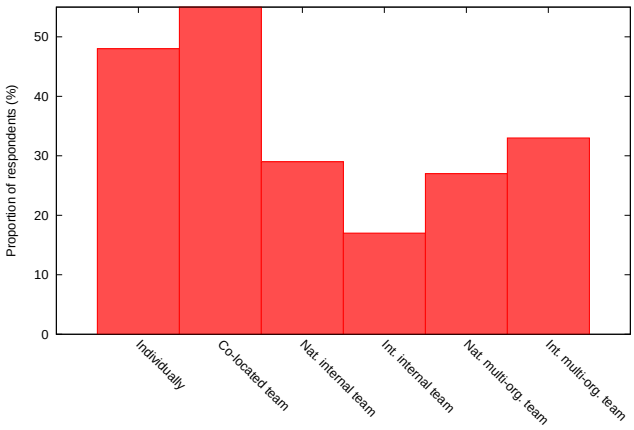


Figure 7.6.: The proportion of respondents who work in each of the different types of team. (Nat. → National, Int. → International, Org. → Organisational)

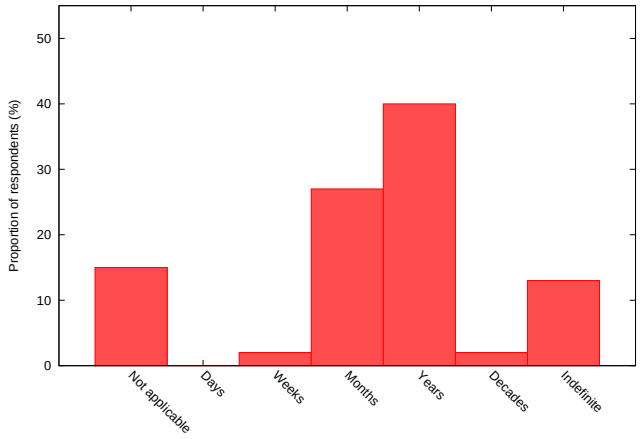


Figure 7.7.: The typical lifespan of a team in terms of the proportion of respondents.

Mechanisms	**Co-located**				**Nat. Internal**				**Int. Internal**				**Multi. Nat./Int.**			
	Y	M	W	D	Y	M	W	D	Y	M	W	D	Y	M	W	D
email				✓				✓				✓				✓
Telephone				✓				✓				✓				✓
Fax.																
Instant Messaging																
Tele conf.											✓					
Meetings			✓				✓			✓					✓	
Informal				✓				✓								

Table 7.1.: Frequency of use of different communication mechanisms with different team types. For compactness the last column represents two team types that returned the same results. (Nat. = National, Int. = International, Multi. = Multi-organisational)

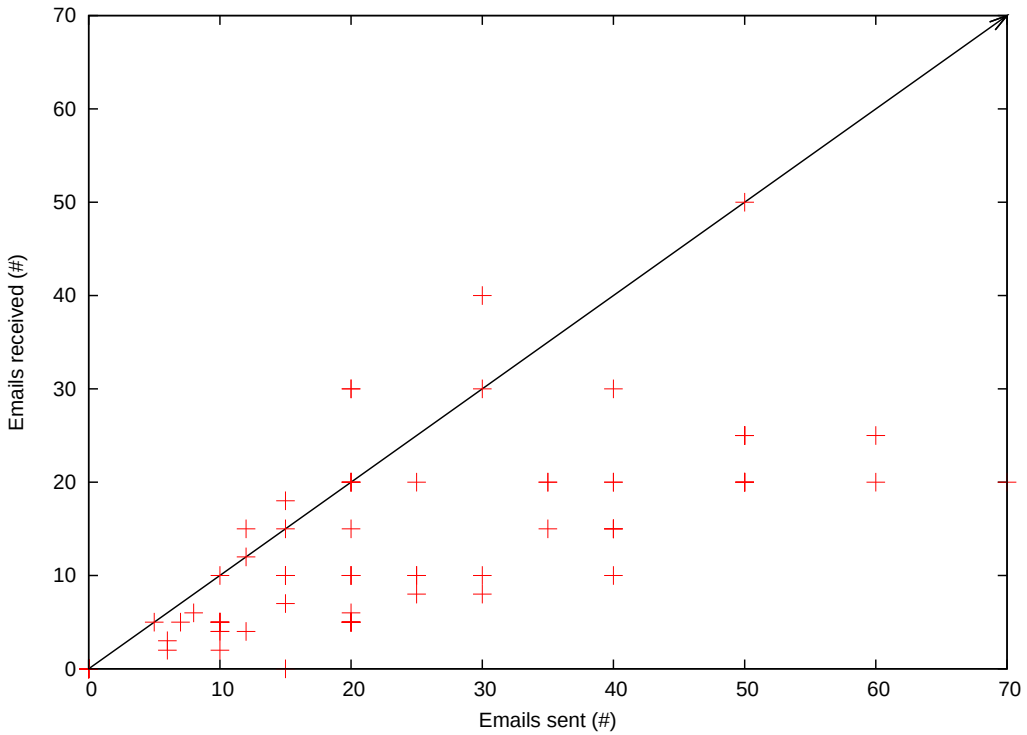


Figure 7.8.: The typical number of email sent and received each day, by each respondent.

Numbers of email sent and received

Questions 11 and 12 asked the respondent to provide the typical numbers of email that he sent and received on a daily basis (not including spam). See Figure 7.8 for a plot of the results. Averaging the results, tells us that the average engineer sends 22 email and receives 12 email each day. The distribution on the plot shows that the population sampled contains a number of individuals who are sending significantly more emails than they receive.

Checking rate

Question 13 asked the respondent how frequently he checked his email at work. See Figure 7.9 for a plot of the results. The results show that 49 % of engineers check their email on an hourly basis, and a further 39 % check their email when they get a notification of a new email arriving. Using the answers to Question 12 the engineers who indicated that they check their emails when they get a notification receive, on average, 15 emails per day (23 % more than the population average), which allows us to infer that 88 % of engineers check their email at least once an hour. This is operating under the assumption that email sending is distributed evenly through the day.

Proportion of email needed

Question 14 asked the respondent to indicate the proportion of email received that was received unnecessarily (not including spam). See Figure 7.10 for a plot of the results. According to 52 % of respondents at least 20 % of the email they receive is unnecessary. An unhappy 2 % reported that more than 80 % of the email they receive are unnecessary.

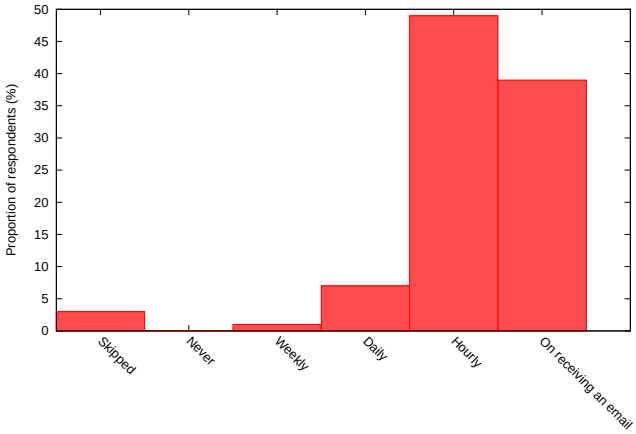


Figure 7.9.: The frequency with which respondents check their email, in terms of the proportion of respondents within each rating. The bar labelled 'Skipped' indicates that a response was not given.

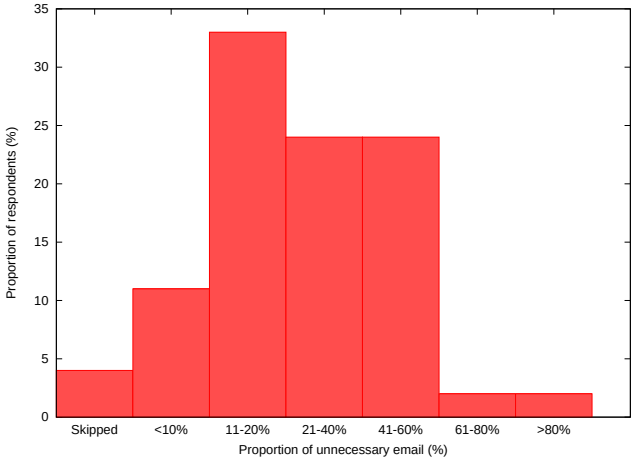


Figure 7.10.: The proportion of unnecessary email (not including spam) in terms of the proportion of respondents. The bar labelled 'Skipped' indicates that a response was not given.

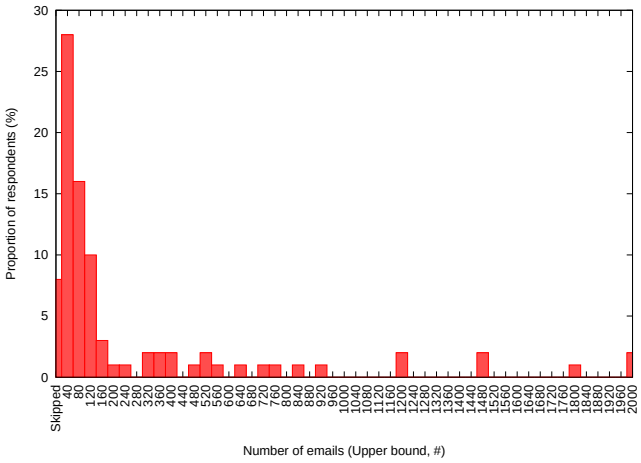


Figure 7.11.: The proportion of respondents against the size of their Inbox. Data is aggregated to form bands, and truncated to remove extreme values (92 % of responses retained). The bar labelled 'Skipped' indicates that a response was not given.

Emails in Inbox

Question 16 asked respondents how many email they currently had in their Inbox. See Figure 7.11 for a plot of the results. In the plot the data has been aggregated to form bands; the proportion of respondents in each band is plotted.

Folders used

Question 17 asked respondents how many folders (tags, or labels) they used for the organisation of their email. See Figure 7.12 for a plot of the results. To plot the results, the data has been aggregated to form bands; the proportion of respondents in each band is plotted, the plot is also truncated to remove extreme values (98 % of the responses are retained). 15 % of respondents do not use any folders, or they skipped the question out of a desire not to answer - the survey design failed to distinguish between these two possibilities.

Total number of email

Question 18 asked respondents how many email in total they had in their system. See Figure 7.13 for a plot of the results. This differs from Question 16 in that it includes all emails in folders. In comparison with Question 16 a relatively large number of respondents (34 %) reported that they have 0 email available to them, or skipped the question. It is proposed that this is due to perceived cognitive difficulty on the part of the respondent in determining how many email were available to them at the time.

Strategies for managing email

Question 19 asked respondents to describe their general strategy for managing email. A grounded approach was used to elicit the key concepts from the responses to this question. These concepts were then grouped into 5 thematic categories: Organising – relates to arranging and ordering; Retaining – relates to storing and valuing; Dealing – relates to handling and work practice; Reusing – relates to finding and working with email and Coping – relates to handling information overload. The results are presented in Table 7.2 and discussed in detail later in the chapter (§7.3.3).

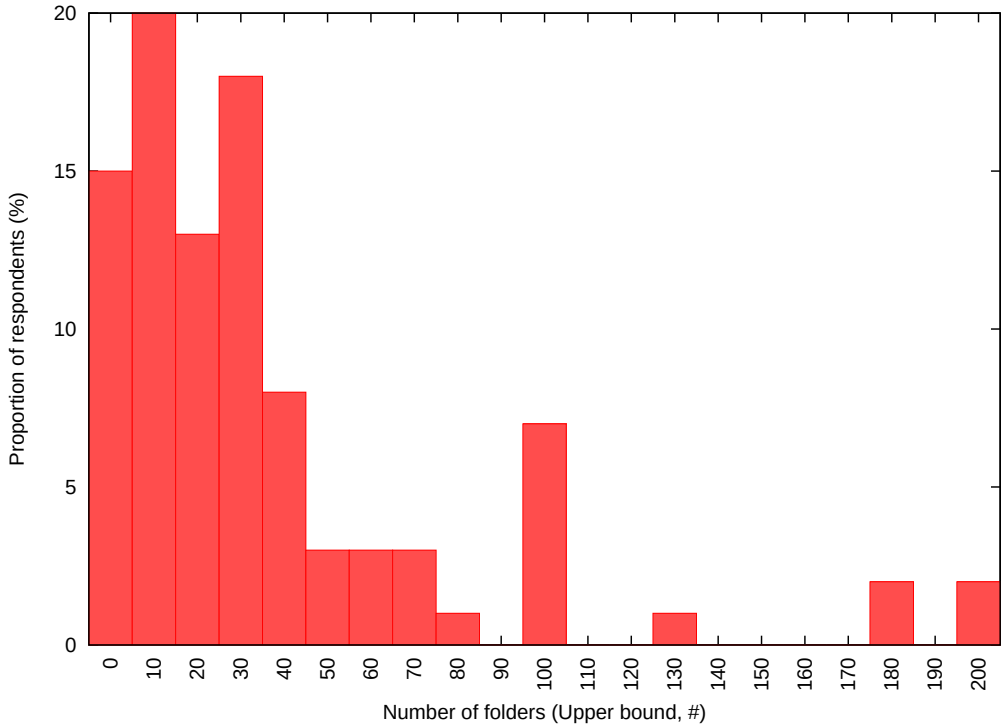


Figure 7.12.: The proportion of respondents against the number of folders they use for organising their email. Data is aggregated to form bands, and truncated to remove extreme values (98 % of responses retained).

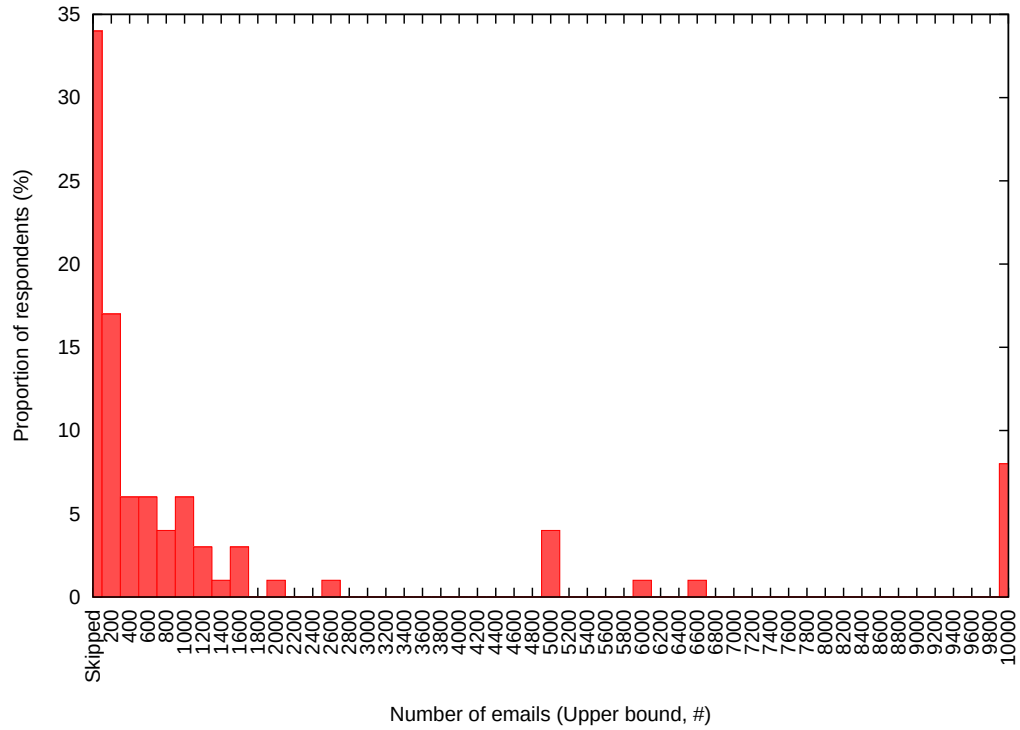


Figure 7.13.: The proportion of respondents against the number of email available to them. Data is aggregated to form bands, and truncated to remove extreme values (97 % of responses retained). The bar labelled 'Skipped' indicates that a response was not given.

Concept	Respondents (%)
Organising	
Use folders (Filer)	55
Organise by projects, customers etc.	15
Use Inbox (Piler)	10
Keep a clean Inbox	8
Filter certain message types	4
Organise in time order	1
Dealing	
Use Inbox for tasks	20
Read, action, delete	14
Use labels and flags to manage work	8
Respond immediately	7
Move tasks to separate system	3
Prioritise	3
Read by topic	1
Read on arrival	1
Retaining	
Delete mass mail	18
Value deleter	14
Offline archive	10
Periodic deleting	8
Delete when space full	8
Move to project IS	6
Store everything	4
Print and file	1
Online archive	1
Reusing	
Search for email	8
Coping	
Does not keep to strategy	3
Weekly clean	1
Allocate time for organisation	1
Has PA	1
Spend spare-time organising	1

Table 7.2.: The categories and ranked concepts elicited from the responses to question 19.

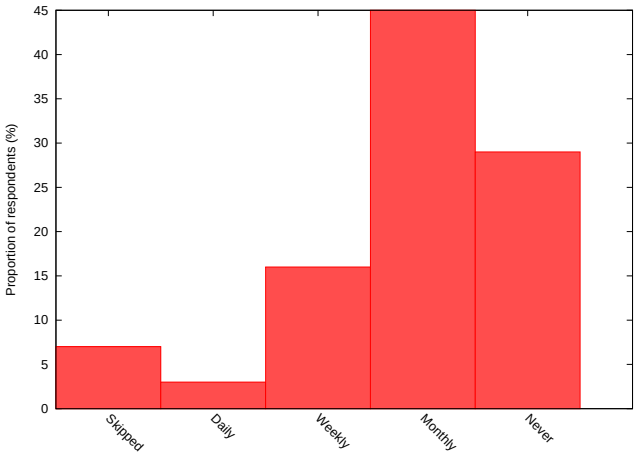


Figure 7.14.: The frequency with which engineers are unable to find an email they are searching for in terms of the proportion of respondents. The bar labelled 'Skipped' indicates that a response was not given.

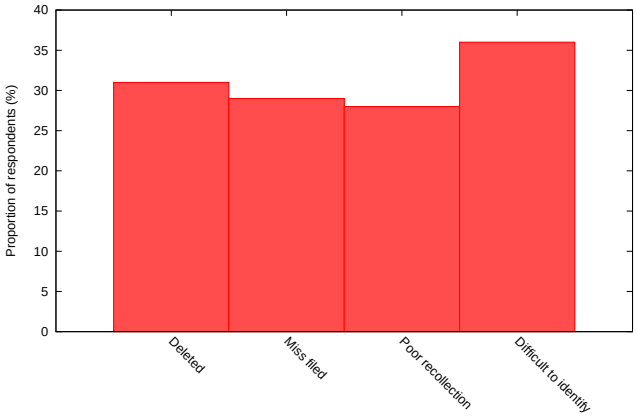


Figure 7.15.: The proportion of respondents who experienced the listed issues when trying to find an email.

Unable to locate email

Questions 20 and 21 asked respondents about their ability to find email. How frequently they found themselves unable to find an email (Figure 7.14) and then to indicate if any of the reasons given were typical for them (Figure 7.15). The results from Question 20 show that 64 % of engineers have difficult locating an email at least once a month, however, 29 % report that they never have difficulty finding an email. From the responses to Question 21 it can be seen that all of the reasons for having difficulty locating an email are present in our population: Deleted (31 %), Miss filed (29 %), Poor recollection (28 %) and Difficult to identify (36 %).

Retention

Question 22 asked respondents whether their retention of email was restricted by storage capacity. See Figure 7.16 for a plot of the results. With 50 % disagreeing and 35 % agreeing that storage capacity restricted their retention, it seems to be a split issue. Capacity can be an issue resulting both because of an overly limiting IT service and

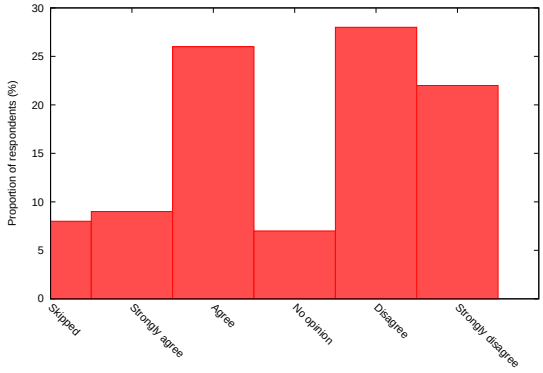


Figure 7.16.: Whether respondents use of email is restricted by storage capacity in terms of the proportion of respondents associated with a particular response. The bar labelled 'Skipped' indicates that a response was not given.

stretched by the particular uses of employees, the results of this survey do not indicate which of these is more of a concern for the 35 % who agreed with the statement.

Question 23 asked respondents how often they archived email for future reference and Question 24 asked how often they then referred to these archived email. See Figure 7.17 for a plot of the results. The results show that 35 % of engineers archive email for future reference, at least once a week, and that 36 % refer to their archived email at least once a week.

Reminders

Question 25 asked respondents how often they used email to remind them of tasks or events. Figure 7.18 shows a plot of the results. The results show that 34 % of engineers use email to remind them of tasks and events on a daily basis, with a further 37 % using it on a weekly basis.

Who controls the archiving

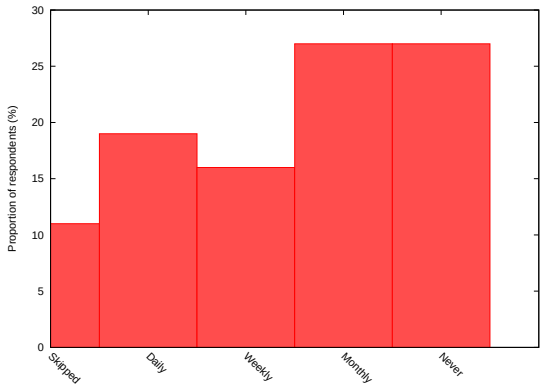
Question 26 asked respondents who controls the archiving of their email, from no one at all to an authorised 3rd party. See figure 7.19 for a plot of the results. 55 % of respondents reported that they were in control of archiving their email, with just 29 % indicating that it was centrally controlled by either their organisation or a 3rd party.

Email policy

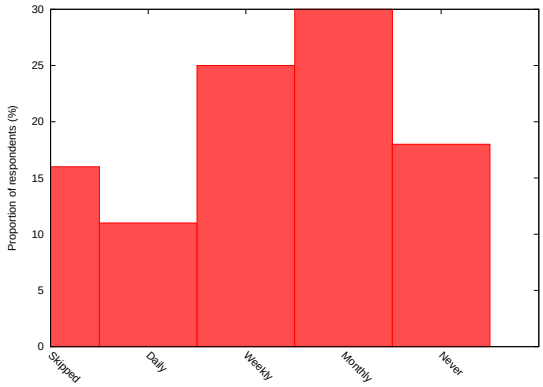
Question 27 asked respondents whether their organisation has a policy on email use. Figure 7.20 plots the results. 79 % of respondents reported that their organisation did have a policy on email use. The survey did not ask respondents whether they were aware of the content of the policy or abided by its provisions.

Training

Question 28 asked respondents whether or not they had undergone any training in email use. The type of training, technical or behavioural, was not specified. Figure 7.21 plots the results. The majority of respondents (71 %) had not received any training in email use. The relationship between the results of Question 27 and this question are discussed later in the chapter (§7.3.4).



(a) Adding



(b) Referring

Figure 7.17.: How often do respondents either add or refer to their email archive in terms of the proportion of respondents associated with a particular frequency. The bar labelled 'Skipped' indicates that a response was not given.

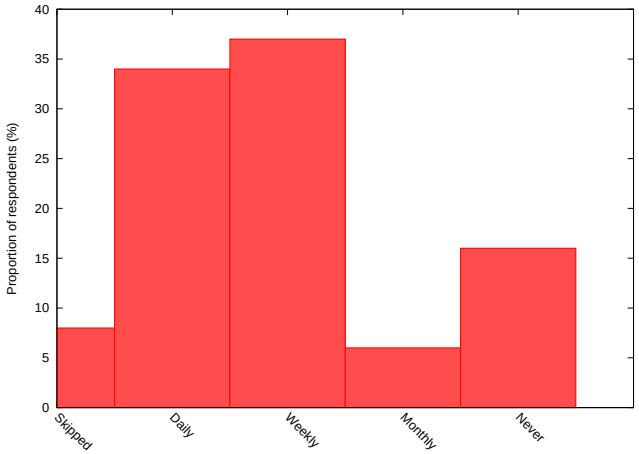


Figure 7.18.: How often respondents used email to remind them of tasks and events, in terms of the proportion of respondents associated with a particular frequency. The bar labelled 'Skipped' indicates that a response was not given.

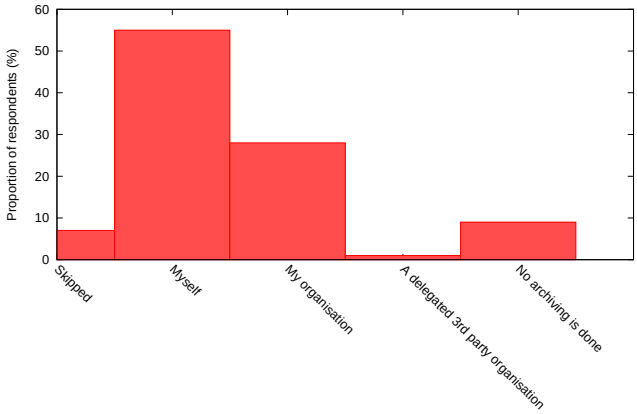


Figure 7.19.: Who controls the archiving of respondents email, in terms of the proportion of respondents associated with a particular option. The bar labelled 'Skipped' indicates that a response was not given.

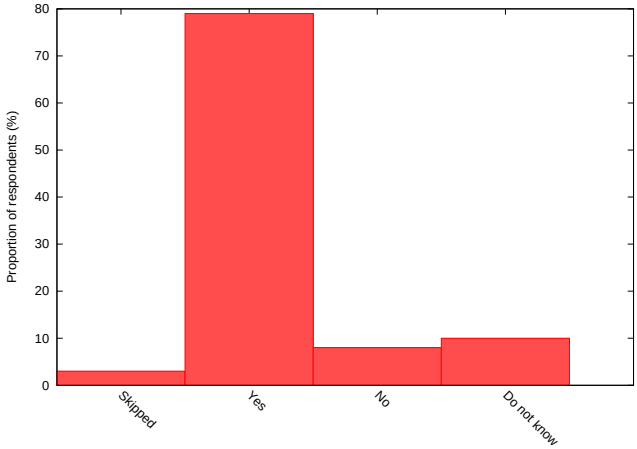


Figure 7.20.: The proportion of respondents responses when asked whether their organisation has a policy on email use. The bar labelled 'Skipped' indicates that a response was not given.

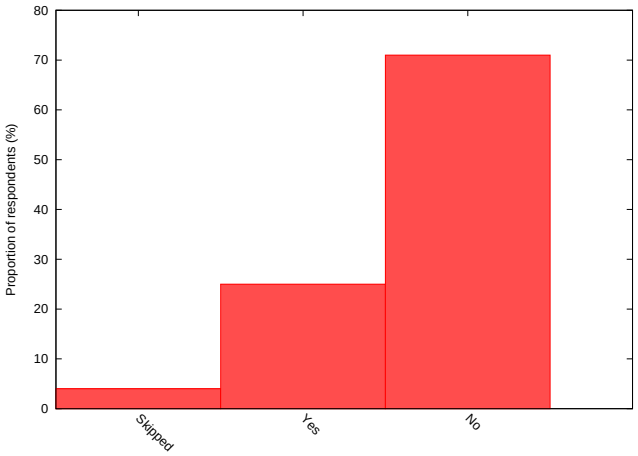


Figure 7.21.: The proportion of respondents responses when asked whether they had undergone any training in email use. The bar labelled 'Skipped' indicates that a response was not given.

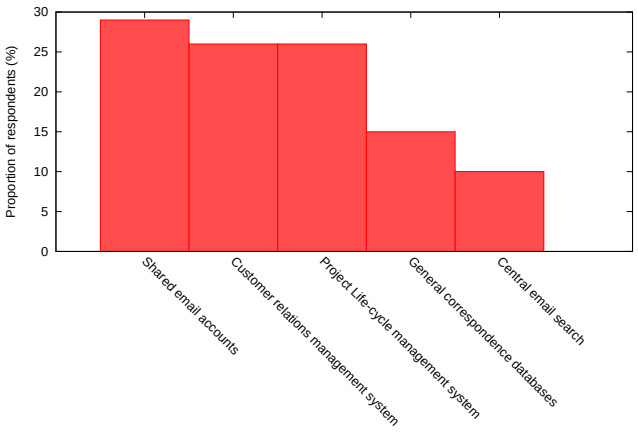


Figure 7.22.: The email facilities available to respondents in terms of the proportion of respondents indicating availability of each option provided.

The 'Do not know' response was omitted for this question under the expectation that everyone should know whether they have done something or not, although the robustness of this assumption is contestable.

Email facilities

Respondents were asked (Question 29) what email facilities were available to them; they were asked to choose from the list provided. Figure 7.22 shows the results.

In retrospect, given the wide range of possible interpretations of the facility descriptions it may have been best to elicit response for this question in a less restrictive way. For example, by providing a free form field and then eliciting facilities from the free text. The intention behind the question was to understand the capabilities and level of sophistication of the email system currently being used by the respondent.

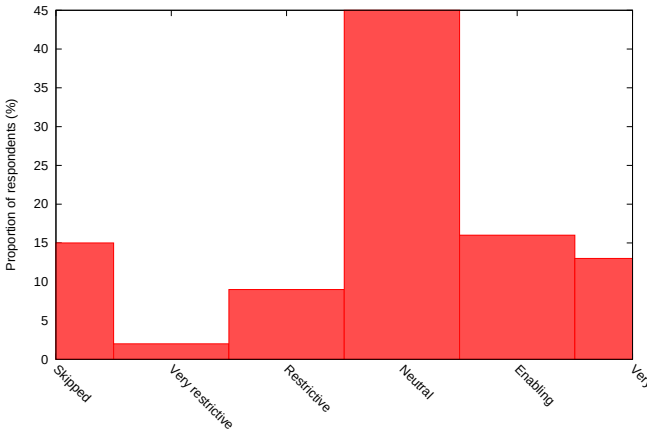


Figure 7.23.: The extent to which respondents feel that their organisations policy restricts their use of email, in terms of the proportion of responses for each option. The bar labelled 'Skipped' indicates that a response was not given.

Start	End	Deviation (% from neutral)
Increases stress	Decreases stress	-7
Decreases productivity	Increases productivity	+17
Creates pressure to response	Gives time to think	-8
Degrades communication	Improves communication	+17
Is overused	Is underused	-25

Table 7.3.: Shows the scale start and end phrases and the mean response for each.

Is policy restrictive?

Question 30 asked respondents whether they felt restricted by their organisations' policies on email. Respondents were predominantly neutral (45 %), feeling neither restricted or enabled by their organisation's policy on email. Perhaps surprisingly, just 11 % felt that the policy was restrictive. This does not however indicate that their organisations had prescriptive policies that the employees understood and did not feel burdened to carry out; it may simply indicate that the policies are not very onerous.

In retrospect, the use of the word policy should have been substituted for a more general term to include the provision or otherwise of particular email facilities.

Perception of email

Question 31 asked respondents to indicate how they felt about email by marking their position along 5 scales. See Table 7.3 for the scales and the mean response for each. The orientation of the emotion of the scales was alternated (a technique to reduce respondent bias[1]). Respondents felt that email was effective, reporting that it increased productivity and improved communication. They also, however, indicated (although less strongly) that when using email they felt greater pressure to respond and unsurprisingly, they strongly felt that email was overused.

[1]Communication with Dr Ian Walker, University of Bath

7.3. Discussion

The following sections discuss the findings of the survey

7.3.1. Communication mechanisms

Question 10 asked respondents to indicate which communication mechanisms a team uses, for each of the different team types that they reported they worked in (given in answer to question 8).

The level of email exchange is greater in co-located teams than in any other, but as this survey did not record absolute levels of communication (just frequency) this may just indicate a greater level of communication in a co-located team.

Telephone usage is high across all team types with a reduction in usage and frequency of usage for multi-organisational teams. Interestingly, there is significantly more telephone usage in international multi-organisational teams than in national ones.

Fax usage is predictably low across all of the team types. Interestingly, its usage is higher for internal teams than for multi-organisational teams. email is typically seen as having displaced the communications niche previously filled by fax and it would be expected that this effect would be most noticeable within the same organisation.

Instant messaging usage is low across all team types, but when it is used it is likely to be used daily which indicates that it is the result of low adoption rather than a characteristic of use of the mechanism.

This question may have been poorly defined, resulting in unusual results. The definition of co-located may have varied between different respondents with regard to the scope of communication that is of interest i.e., with-in or with-out the team. This can be seen in respondents indicating that they use phone and video conferencing when working as co-located teams. It is also possible that the results are being affected by the relatively small number of respondents who work in the other team types. The question was intended to relate to communication within the team a respondent was a part of.

7.3.2. Perception of email

The questions which reflect the respondents' perception of email include questions: 31, 14, 19, 20, 22 and 30. The 5 scales provided by question 31 give the most direct indication of perception in terms of an engineers' emotive response to email; although respondents reported that they felt email improved communication they felt that it also increased stress.

They particularly strongly felt that they received more email than they needed to and this is reinforced by the responses to question 14 in which 52 % of respondents indicated that they did not need to receive at least 20 % of their email. It is further reinforced by the comments of respondents provided in question 19 (§ 7.3.3) in which 18 % of respondents reported immediately deleting mass emails and others they considered as not applying directly to them. However, for question 22, 35 % of respondents reported that their use of email was restricted by storage capacity, but 50 % disagreed.

In response to question 30 just 11 % felt that their organisation's email policy was restrictive. This does not however indicate that their organisations had prescriptive

policies that the employees understood and did not feel burdened to carry out; it may simply indicate that the policies are not very onerous.

7.3.3. Strategies

Question 19 asked respondents to describe, in free form, their general strategy for managing email. The results are presented in Table 7.2. The following sections discuss some of the key concepts in each of the topics.

Organising

Engineers are Filers (55 %), with just 10 % admitting to being Pilers [51]. For the remaining respondents it was not clear whether they used an approach for organising their email.

Using organisation level categorisation approaches is common (15 %) and could arguably be used to support moving information into the project Information Systems (which was reported as being less common 6 %). Suitable organisation level categorisation might include: projects, products, organisations, accounts and contracts. This finding also reinforces the value in the identification of consistently and explicitly identifiable information within the content of emails to improve their re-usability and find-ability.

Retaining

Of the responses 18 % mention immediately deleting email sent from mailing lists such as Human Resources. When used to broadcast information to a large number of employees email has significant overhead associated with it in comparison to other communication mechanisms such as forums, bulletin-boards and syndicated content. As such it is arguable that training should be provided to those responsible for internal communication on the advantages, disadvantages and costs of the different communication mechanisms available.

Of the responses 14 % mention using an evaluation of the long-term value of an email when deciding whether to delete it or not. Compared with 16 % who reported either using periodic deletion rules or when space is full. Just 4 % stated that they 'keep everything'.

Dealing

Bellotti has described the central role of email in task management [52], and it seems that engineers are no exception, with 20 % of the respondents using their Inboxes for managing tasks. Bellotti embraced this role for email and rather than trying to alter users behaviour by having them use discrete task management tool she argued for the enhancement of the email client to support this role. Just 3 % of our respondents mentioned that they move information into a separate task system.

Many respondents (14 %) described (some with considerable relish) how they ruthlessly follow a read, action, delete process for dealing with their email. In some cases this direct approach was tempered by the recognition that they may retain some email that they feel may be of value in the future.

Coping

Just 3 % mentioned not being able to keep to their particular strategy for managing email, it is suggested that this is likely to be under-reported. The question simply asked

what the respondents strategy was without indicating that that they should include information about what they actually did (as opposed to what they intended to do).

Reusing

There was very little mention of retrieval or reuse of information; with 6 respondents reporting that they search for information, with half of these being Pilers (relative to just 10 % of all respondents 'admitting' to being Pilers).

7.3.4. Managing email

It could arguably (but perhaps not safely) be considered self-evident that training employees on the requirements or expectations of them when producing documents would lead to better conformance with those requirements and expectations. A lack of training is the anecdotal target for much conversation on the issues surrounding email use, and it is borne out in the survey, with 80 % of respondents saying that their organisations' do maintain policies on email use, and yet 70 % say that they have been provided with no training on email use. Further weight is added to the concern raised by this finding when 53 % of respondents also report that they are responsible for the archiving of their own email.

Of the respondents, 67 % report that they refer to archived email (where archiving refers to 'long term storage, with at least the ability to search for and retrieve documents'), with 37 % doing so at least once a week. This suggests that email is a valuable source of information to engineers during their work, however, 33 % use their email to remind them of tasks on a daily basis, which also suggests that many emails are likely of short term value.

As was to be expected there was a divide between digital natives and digital immigrants when considering the age of respondents [74]. For respondents under 55 computer and email usage do not vary significantly, with those above 55 showing a slight reduction in usage. A 2nd divide was not evident at the age of 25 or under. Given the size of the sample relative to the population it would be inappropriate to draw too much from this feature, however, it might be worth noting that the digital divide that might be expected with those born during the Internet Age may not be present in this data because the questions dealt only with long existing technologies, whilst their relative usage (now that the technologies in question are pervasive) is more likely to reflect the role of the respondents than familiarity or willingness.

80 % of respondents had between 500 and 1000 email in their Inbox, with 70 % reporting that they had between 1800 and 3500 email in total. 50 % reported that they do *not* find that storage capacity restricts their retention of email, whilst 36 % do find it restrictive.

7.3.5. Summary

Responses to question 10 demonstrate that email is a dominant communication mechanism within engineering.

Responses to questions on the perception of email among engineers indicate that is considered to be a useful tool for communication. Many, however, are also frustrated by the volume of communication; particularly by the volume of email that they believe they do not need to receive.

It has been shown that the use of categorisations that are consistent within the organisation is relatively common (§ 7.3.3); this reinforces the conclusions of the email content analysis study (Chapter 6) that suggested that there is value in embedding explicit organisational and contextual information within an email. This finding is also reinforced by the analysis of the email corpus with respect to understanding the relationships within the corpus (Chapter 8) that identified this same organisational contextual information as improving the richness of the understand which can be gained from the corpus.

7.3.6. Contributions to knowledge

- Collected and presented detailed responses from 89 individuals on their email practice and perception.
- Identified a number of facets of engineers perception of email that are of direct benefit to Information System managers within Industry. (§ 7.3.2)
- Identified that engineers appreciate the value of information stored in emails and regularly make use of old emails. (§ 7.3.4)

8. Relationships

Contextual information was one of the two underlying factors identified in the review of the literature (Chapter 3). This chapter summarises a short investigative study of potential for retrospective creation of contextual information by the automated identification of significant individuals and relationships from a corpus of email.

The investigation is carried out from the perspective of engineers' reuse of project information, specifically, the need to aid project managers and engineers to understand old or unfamiliar projects by facilitating communication with colleagues with the most pertinent understanding of the project or of a particular phase of the product life-cycle.

The investigation serves as an illustration of the potential of using information obtained from the analysis of communication activities. The investigation focused on improving the visibility of the individuals associated with a project, with the ambition of aiding information seeking activities.

A paper presenting this investigation has been presented at Product Life-cycle Management 2009 (PLM'09) [75].

8.1. Background

It has been shown that engineers rely on colleagues when information seeking, however, currently PLM systems do not attempt to facilitate this. The approach used in this investigation would provide a simple human *index* to existing PLM systems which currently use only categorisation and keyword search techniques.

This chapter presents an investigation of the use of relationship modelling for the automated identification of the significant relationships and individuals who have been involved in a given project. This investigation aimed to explore the potential for engineers to reuse project information, particularly with regard to old or unfamiliar projects, to identify and facilitate communication with colleagues with the most pertinent understanding of the project or of a particular phase of the product life-cycle.

The effectiveness of information seekers is limited by their familiarity with the Information System they are searching and the categorisation used. In interviews and studies engineers (and knowledge workers in general) have been shown to turn to colleagues with a better understanding of a particular repository to aid their searching [60, 76]. Aligned with this is the understanding that knowledge workers then spend significant amounts of time locating colleagues who can (have the appropriate expertise to) help them in their current activity [17, 77].

In the past where project teams were co-located and relatively static, engineers could build up extensive knowledge of the experience and capabilities of their colleagues. However, in today's dynamic highly distributed project teams such understanding is difficult to elicit, and is further frustrated by the prevalence of large, complex and

long-life engineered systems, such as aircraft, ships and buildings. This change in the nature of engineering activities and the wider product life-cycle has given rise to the development of Product Data Management (PDM) and Product Life-cycle Management (PLM) systems [25]. Whilst such systems have undoubtedly revolutionised working practises and information management strategies their ability to support the capture of key relationships and stakeholders (people) over the product life-cycle is all but limited to *a priori* cases. For the reasons previously stated such cases are relatively infrequent and in general significant relationships, between for example engineers and key stakeholders, such as decision-makers, can vary dramatically over the product life-cycle and over different phases of the product life-cycle.

To begin to address these issues a number of studies have focused on approaches to identify the significant individuals in an organisation [60, 61]. These studies were undertaken for the purposes of representing informal structures and communities within organisations [60, 61] and also for 'Expert Finder' systems.

Skovvang et al. have coined the term 'personometrics' to describe the study of people as sources of information [78]. Their work was based on the application of citation analysis techniques to relationships identified in interviews with engineers working on a research and development project. They explicitly identify the potential of their work for aiding the design of people-finding systems. Although their work is based on data collected by questionnaires, the need for automated methods for relationship data retrieval was highlighted as potential further work. It is proposed that one possible means for this is to consider email communications.

email has been identified as a valuable resource for organisational learning [79], in particular for the identification of communities [61] and to indicate collaboration [49]. As a consequence of the pervasiveness and prevalence of email and the need for more automated methods to support relationship capture this chapter explores the potential for identifying relationships and significant individuals from email archives and in particular those associated with past projects.

For the purposes of this investigation the relationship model is generated using the email corpus described in Chapter 5. The method of relationship captured and modelling is discussed first and the background to the engineering project summarised. The relationships are identified in the corpus and the relevance of the relationships are evaluated with respect to an understanding of the corpus elicited from interviews with project participants and reference to project documentation.

8.2. Modelling

email files are processed to produce a relationship model of the email corpus using software developed by the author. The resulting model consists of three object types (classes): email, in which each instance is a direct representation of an individual email; Person, in which each instance corresponds with a unique person identified within the address fields of the email and Relationship, with which each instance represents all exchanges of email between two unique people.

To produce the relationship model the software extracts the meta information from each email file and processes it to identify unique individuals. Instances of email and Person objects store each unique email and person, respectively. A second process then

maps the relationships described by the addressing information in each email. With one Relationship instance representing the exchange of email between two individuals.

Two Person instances are only ever linked by one Relationship instance i.e. the instance contains all of the email exchanged by the individuals it represents. The Relationship objects maintain the full index of exchanges between the two individuals, including the origin of the exchange. Using this information the relationships can be represented as a network using a directed graph with weighted edges.

Once the model is created, analyses can be performed to identify the significant relationships present within the model, both for the whole corpus and for particular time periods (phases) within the project.

The approach takes the relationships as the unit of analysis, rather than the person, so that it is possible to assess the appropriateness of a particular relationship being present within a given phase of a project, and therefore the validity of the results. Also, as is discussed later, relationship information can be used to aid the presentation of information to the user (§ 8.2.2).

8.2.1. Significant relationships

One frequent problem with performing network analysis on an email corpus is the large number of relatively insignificant relationships and people present within the network. These insignificant relationships conspire to make an already 'small world' network even smaller [80].

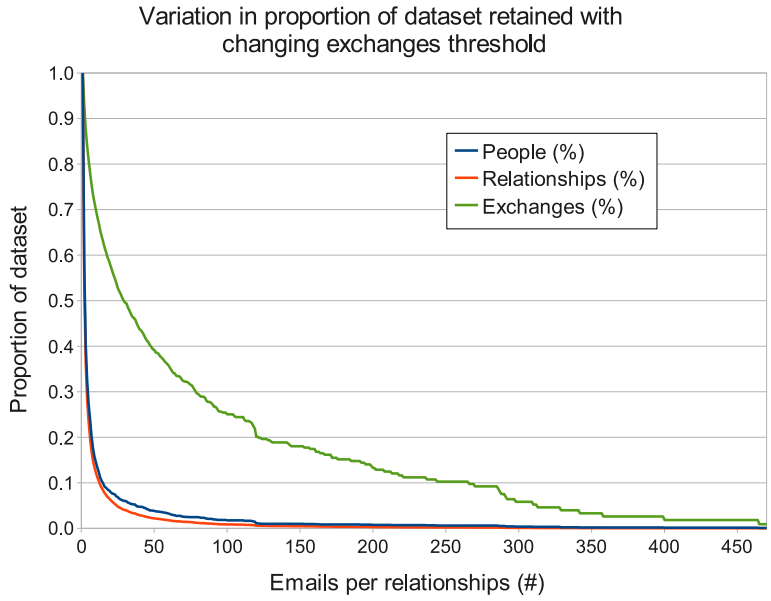
If we consider that a relationship consists of a number of email exchanges between two individuals, then a simple approach to reduce the number of insignificant relationships is to set a threshold for the number of exchanges that are considered to constitute a 'meaningful' relationship. Figure 8.1 shows the effect of changing the threshold against the proportion of email exchanges, people and relationships which is represented by the resulting data set. For example, by considering a 'meaningful relationship as consisting of 3 exchanges then relationships just consisting of a single sending and reply activity are removed from our analysis. Putting the threshold at 3 exchanges, then 88 % of the exchanges are retained, and proportions of the people and relationships are reduced by 59 % and 63 % respectively.

8.2.2. Relationship maps

The maps of the relationships used in the results section (§ 8.4) of the whole projects and of the specification phase (Figures 8.3(a) and 8.3(b) respectively) do not use conventional graph representations. They deviate in that they represent the number of exchanges by scaling the size of the vertices, rather than applying labels to the edges. This was done to allow for a more intuitive (and immediate) representation of the significance of individuals within the corpus.

The graphs also represent the primary direction of communication, rather than separating communication into two separate edges. Our analysis does not consider the direction of communication to have any effect on the significance of a relationship. This may be a limitation in the analysis, as the relative mutuality (i.e. the ratio of email sent by each party) of a relationship may be a reflection of its strength.

Figure 8.1.: A graph showing the effect on the proportion of data within the data set as results of changing exchange threshold (This uses the corpus described later in the chapter (§ 8.3))



The form of the figures was chosen both to aid the reader and to suggests a potential method of aiding the information seeker to understand the significant relationships and individuals.

Rather than just providing a ranked list, providing a map with intuitive indicators of the relative significance of the different individuals allows information seekers to make their own assessment of the most appropriate individual to approach. The map might show that, previously unknown to them, one of their immediate co-workers was heavily involved in the project they are seeking information on.

8.3. Case study

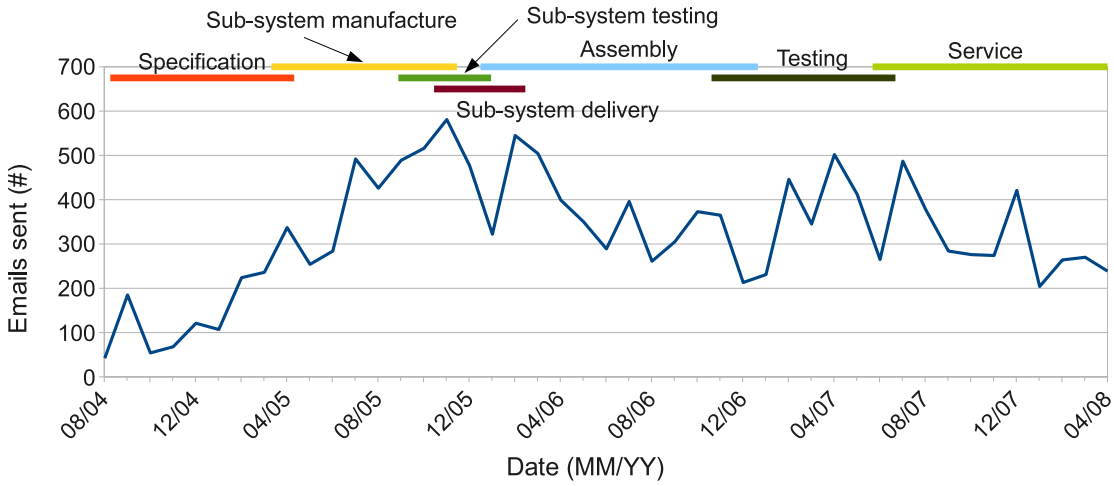
In order to explore the potential of relationship capture the approach described was applied to the example data set made available by the industrial partner of this research. The details of the data set project and of the industrial collaborators are described in Chapter 5.

To reduce the density of the graph of the corpus the threshold for a significant relationship (§ 8.2.1) was set at 3. With this limit 88 % of the exchanges are retained, and proportions of the people and relationships are reduced by 59 % and 63 % respectively.

The email corpus was provided in the form of a single plain text export from an internal project management application based on the Lotus Notes[1] platform. This export was processed to separate out the content into single email, standardise the form of email headers and to format the email in accordance with RFC 5322 [81].

[1] http://ibm.com/lotus/notes/

Figure 8.2.: A plot of the volume of email (aggregated by month) through the life of the project, with the project phases overlaid.



8.3.1. Additional sources

For the purpose of assessing the validity of the relationships identified from the corpus two additional sources of information were obtained. These included a set of project planning documents and and a series of interviews with the key engineers. These provided additional context and enabled the assessment of the results of the automated analysis.

The planning documents were used to identify the major phases (see Figure 8.2) in the project, the job titles of individuals and the organisational structure of the project. By combining the three, the appropriateness of the relationships identified could be interpreted.

Figure 8.2 shows the phases of the project overlaid on a graph of the number of email sent per month across the life of the project. The project was primarily an integration project, with the Company filling the role of a Tier 1 supplier for several major sub-systems. As a consequence of this, the project involved relatively little design work and that which was undertaken was considered as part of the specification phase.

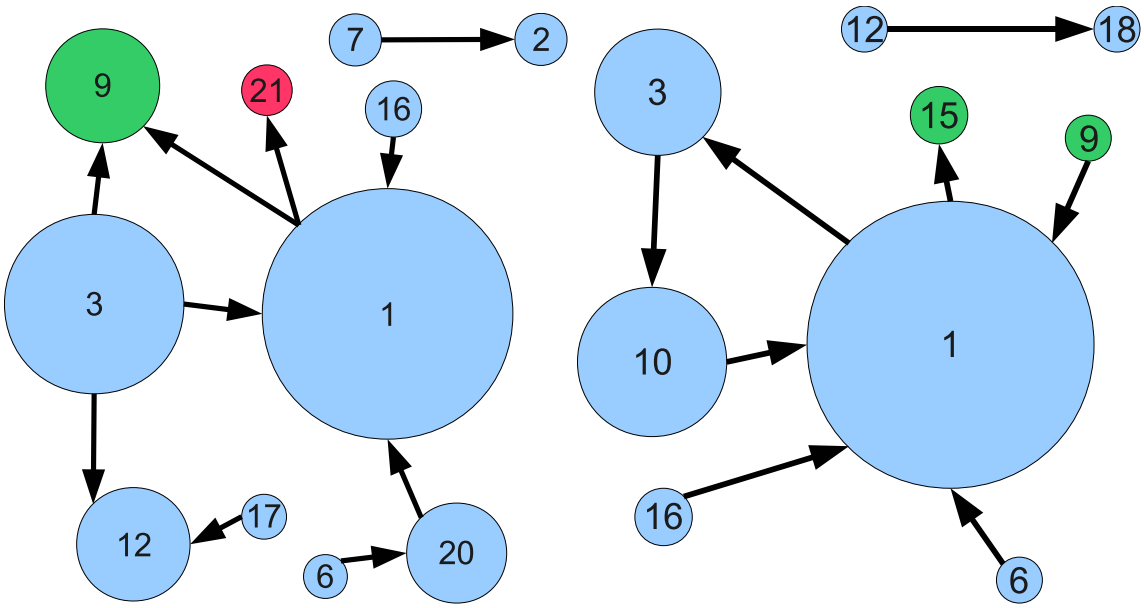
Semi-structured interviews, lasting for 30 minutes each, were held with 6 engineers from the project team. All of the engineers were still involved with the project in the same capacity, although only 3 were still spending significant time on the project. The interviewees were sampled to provide broad coverage of the roles within the project.

8.4. Results

For the purpose of identifying significant individuals and relationships two levels of analysis were performed. An analysis of the entire corpus (macro level) and of the various project phases (micro level). The following section discusses the results.

For the purposes of the presentation of results and for the following discussion, individuals will be referred to by their roles. Where necessary to identify specific individuals the following syntax will be used:

`<rank>␣[<site>]␣<role>␣[<x>](<y>)`



(a) The life of the project (b) The specification phase

Figure 8.3.: Diagrams showing the significant relationships identified. The key for the individuals is in Table 8.2

Where **x** is an identifier used if the role name is shared by another individual in the data set and **y** is a chronologically sequential identifier used if more than one individual has held the same role over the length of the project. If the individual is a member of the Customer or User organisations then Customer or User, respectively, is prefixed to their role, in bold text.

Figure 8.4.1 presents manually constructed graphs of the individuals and the relationships between them. With individuals represented by the vertices of the graph and the relationships represented by the edges. The sizes of the vertices are scaled relative to one another, with respect to the total number of exchanges handled by the individual they represent. The graphs were constructed manually due to time constraints and presentation requirements, there are a number of software libraries [2] for the automatic construction of such graphs.

8.4.1. Whole corpus

The ten most significant relationships during the life of the project are identified (depicted in Figure 8.3(a)). This shows that the Project Director is the most significant individual in the corpus, both in terms of the number of relationships which connect him to other individuals, the number of connections to external parties and the total number of exchanges. The next two most significant individuals are the Project Manager of Site B and one of the Customer's Project Managers, respectively. These individuals were responsible for coordinating the project across the three sites, so it validates the approach that they are represented in the network as independently connected by strong relationships.

[2] http://graphviz.org/ & http://cneurocvs.rmki.kfki.hu/igraph/

Phase	Relationships	Individuals
Specification	3→10, 10→1, 16→1, 1→15, 6→1	1, 10, 3
Sub-system manufacture	1→3, 9→1, 9→10, 3→4	1, 3, 9
Sub-system testing	5→1, 1→3, 19→12, 1→4, 1→12	1, 3, 12
Sub-system delivery	4→5, 11→1, 5→11, 17→1, 3→4	5, 11, 4
Assembly	2→1, 8→6, 4→5, 5→11, 8→1	1, 6, 8
Testing	10→2, 2→1, 9→1, 8→1, 8→6	1, 2, 8
Service	2→7, 2→1, 6→1, 14→1, 7→1	1, 2, 7

Table 8.1.: A table showing the top 5 most significant relationships in each phase and the top 3 most significant individuals. The numbers correspond to the people listed in Table 8.2

8.4.2. Per phase

The project involved 7 phases (see Figure 8.2), the result of the analysis of the significant individuals and relationships identified in these phases is now discussed.

Specification The most significant relationships in this phases were between the Project Director, the Project Manager of site B and the Design Integrator for the project. The other signification relationships show the Project Director in communication with the Customer's Project Managers directly and through the Company's Customer Liaison employee.

Figure 8.3(b) presents a diagram showing the significant relationships identified within this phase of the project. From the diagram it is clear that the most significant individual in this phase is the Project Director.

Sub-system manufacture 3 of the 5 relationships identified as significant in this phase are between the project's senior management team and the Customer.

Sub-system testing and delivery The majority of the relationships identified in these two phases represent the project's senior management.

Assembly In this phase a relationship between Project Support and the Project Director becomes the most significant in the project.

Testing The Project Support roles remains as the most significant role, in communication with both the Customer Liaison and the Project Director.

The majority of relationships involve communication with the customer, either directly through their project managers or through the Company's Customer Liaison.

Service The Project Support and Customer Liaison roles remain as significant in this phase. There is no direct communication with the Customer represented in the significant relationships in this phase.

8.5. Discussion

For the purpose of this exploratory study the results are discussed with respect to the ability of the approach to identify significant relationships and individuals, implications for PLM and directions for further work.

Id	Description	Id	Description
1	[A] Project Director	11	[C] **Customer**, Project Manager [2]
2	[A] Project Support (2)	12	[A] Project Support (1)
3	[B] Project manager [1]	13	[C] **Customer**, Project Manager[3]
4	[B] Lead Engineer	14	[B] Project Manager [1](2)
5	[A] Design Integration (2)	15	[C] **Customer**, Senior Project Manager
6	[A] Project Manager [2]	16	[C] Customer Liaison (1)
7	[C] Customer Liaison (2)	17	[A] Contract Manager
8	[C] **Customer**, Manager	18	[A] Supplier
9	[C] **Customer**, Project Manager [1]	19	Supplier
10	[A] Design Integration (1)		
20	[A] Site Manager	21	**User**, Liaison

Table 8.2.: A table of significant individuals within corpus that were identified during the phase level analysis, ranked by the total number of email exchanges that they sent and received. 20 & 21 were significant individuals across the whole project, but not within the phases - they are included outside of the ranking of the others

8.5.1. Service phase

There is a conspicuous absence of relationships involving the Customer and the User in the Service phase of the project. There is one relationship between the Company's Customer Liaison and the Project Director, however, in previous phases there were also numerous direct relationships.

An explanation may be that this is the result of the User not having significant contact within the Company to allow for lower level communication. Or that now that the contract has been handed over to service, communication is taking place using a reporting channel which is not visible in this corpus of email. An interview with the Service Engineer responsible for managing the service agreement with the User revealed that they do maintain a separate correspondence database, and as a result it will only be internal communications (within the original project team) that make it into the corpus during this period.

This incompleteness highlights the need for a careful assessment of the corpus being used for the identification of significant individuals. Also, more generally, it points to a significant problem in the record keeping process for this project. The hand over to Service has resulted in a fragmentation of the project records.

From the perspective of identifying the significant individuals within the project, the primary contacts within the User company or even who is handling communication with them, within the Company cannot be identified.

8.5.2. Site B

Figures 8.3(a) and 8.3(b) show that there is very little communication with Site B and the other two sites. Where as a number of relationships span Site A and C. This could be a reflection of the main project management activities being undertaken at Site A (§ 8.5.4).

8.5.3. The User

When looking at the relationships identified within the phases there is no indication that the Company is in direct contact with the User to a significant extent. However, the User's Liaison appears within the relationships identified from across the whole project. An analysis of the individual's email exchanges shows that they were communicating consistently at a relatively high level throughout the life of the project, but not at a level high enough, in any one phase for them to be identified as forming part of a significant relationship.

This observation highlights a potential disparity when identifying relationships across the life of the project when compared with identifying them within each phase.

8.5.4. Stakeholder representation

Of the relationships identified, none of them include people outside of managerial roles, with the exception of those individuals in support roles, such as Project Support and Customer Liaison. The interviews with the project members indicated that some individuals were more likely to communicate by email than others. The amount of email an individual sent would be affected by a variety of factors: personal preference, type of role and proximity of colleagues. Given this insight it cannot be assumed that this corpus represents a complete record of the communications between all parties involved, however, we assume that email provide a representative sample of communication.

However, one possible consequence of this, at least for the corpus examined here, could be that sites or groups which do not engage in project management activities will be under-represented or not present at all in the relationships identified by this approach. This is observable in the relative isolation of Site B (§ 8.5.2) and the lack of less senior engineers within the results set.

This bias may not effect the value of the results set. It may be argued that in the majority of cases project managers would be best placed to aid the information seeker in terms of access to project records and assessing their suitability to the seeker.

8.5.5. Implications for improving PLM

Whilst the observations suggest that this approach is unlikely to identify all of the significant individuals involved in a project, and may be strongly biased towards the identification of a limited subset of project participants, the method has been shown to be able to generate knowledge of the significant relationships. Furthermore, it has revealed how relationships change over the project life and the important relationships at key stages of the project. From a PLM perspective it is self-evident that capturing those relationships can offer significant benefit for information seeking processes. Knowledge of these individuals may not only provide points of contact but may also provide additional means for information access through knowledge of the author(s).

When viewed as a means of assisting the information retrieval process, it is a low cost approach to reducing the time and cost of information retrieval. None of the observed limitations indicate that information seekers would be given erroneous suggestions based on the individuals identified using this approach.

8.5.6. Further Work

The utility of returning the relationships identified by this approach to the information seeker has not been investigated. Studies have shown that information seekers would benefit from this kind of information, but whether issues such as trust and credibility would affect its acceptability have not been investigated.

The number of corpus to which this approach has been applied are also required, to ensure that the characteristics of this corpus have not masked significant problems with, or limitations of the approach.

Another interesting avenue of research lies in combining this approach with automated content characterisation techniques [71]. This would allow for the identification of relationships and individuals associated with particular expertises or knowledge of particular sub-systems within a project. The understanding gained from this would be particularly useful to the expertise mapping community - as well as providing additional clues to information seekers.

The understanding of individuals involved with a project offered by this approach could be used to integrate disparate personal information sources such as personal files [2] and logbooks [13].

Additional potential future work includes combining this approach with automated content analysis of the email corpus to provide identification of individual with particular expertise or knowledge.

8.5.7. Summary

In this Chapter an approach for eliciting relationships using email records has been proposed as a pragmatic approach to aiding information seekers by providing a human index to project information. The approach would provide a simple human *index* to existing project information management systems, which currently use only categorisation and keyword search techniques.

The review of the literature identified context as being the underlying factor behind many of the issues with current email systems and practices. The approach presented in this chapter can be seen as an attempt to retrospectively derive context by analysis of aggregate patterns of communication. It is possible that future communication systems will explicitly capture this information. Currently, additional improvements in understanding the communication networks would be achieved by incorporating additional information about the individuals involved (capturing additional context) within the original email.

Specific examples of the information which would, by being incorporated in the email, produce a richer understanding of the communication networks include the explicit references to projects, products, components, sub-systems, people, companies, work-tasks, documents etc., which an email is discussing or is associated with. By providing references to external entities improves the effectiveness of information seeking mechanisms such as categorisations and multi-faceted search.

8.5.8. Contributions to knowledge

- Identified a disparity between the individuals represented in the email corpus and the individuals involved in the detailed project work. (§ 8.5.4)

- Developed and described a method for analysing relationships between people within a project email corpus. (§ 8.2)

Part III.

Intervention

9. Proposal

The aim of this chapter is to integrate the conclusions from the literature and investigative studies in order to summarise the requirements for improving the use and reuse of email to as records of engineering work. Specifically this chapter addresses Research Question 4 (§ 4.2).

The summary presented below should not be seen as an exhaustive set of requirements for transforming email into an ideal record keeping system, but rather as the core set of requirements that have emerged from the understanding developed. As such, these requirements will be presented in the form of scenarios that describe "critical instances" of the use of email in engineering.

The requirements are synthesised from the literature and investigative work described in the preceding chapters. They have been developed to characterise the use of email in engineering, and to present the challenges associated with clear instances of use of email in engineering projects. These requirements contribute to the basis for evaluating new tools and approaches that aim to support engineering work and provide clear and effective communication of the challenges to the wider research community and industrial stakeholders. Eckert and Stacey (2001) [82] have expressed the need for a scenario based approach when communicating requirements in design, and have presented a number of dimensions that can be used to describe common communication situations in engineering – developed using their experiences of empirical research in industry. They go on to use these dimensions to make requirements that show typical work situations to consider when designing and developing tools that intend to support engineering design work. Wild et al. [83] also used scenarios to "provid[e] requirements for future document support software" in the context of engineering design; noting that they used scenarios specifically to facilitate up-take of findings by the widest set of researchers and industry stakeholders. Bødker and Christiansen [84] describe scenarios for use in the context of the design of collaborative software system as "exist[ing] in the borderland between experience and expectation" and that they are also "meant to provoke new ideas" [84, p. 225]. They further prescribe that:

> Because scenarios are not empirical situations, they should be 'stories' located in time and space, 'traces' featuring details, not 'novels', and they should be designed based on knowledge about typical ways of doing things, but addressing specific, critical instances of the typical. [84, p. 225]

9.1. Requirements

In the following section, requirements will be framed as scenarios of typical email use, using the conclusions from the literature and investigative studies to offer inspiration and detail. The intention being to make requirements that specifically describe "critical instances" of the use and potential uses of email in engineering, thereby highlighting

both challenges and opportunities for improvement. Each requirement will be introduced and the evidence supporting it will follow with references to the supporting sections of the report.

1) Process Integration

For the purpose of constructing a complete record of the engineering work carried out within a project the Project Manager needs to understand how the email sent relate to overarching processes and tasks within the project, and the artefacts, such as models, specifications, that are produced during the course of the project.

Evidence

Issue 6 identified that emails have no explicit relationships with processes and that it hampers long term retrieval.

Issues 10 and 19 describes the additional importance of relationships with other Information Objects and in particular design artefacts, which can be achieved through common reference to processes.

Issue 21 suggests that association of emails with processes would provide opportunities to improve understanding of the efficacy of the processes.

One example of such a process is a Project Manager's need to see all emails associated with "anything contractual" such as to retain "commercial control" of the project; a process that is particularly difficult during busy periods when he is "swamped and the engineers [are] going direct" to the customer (§ B.1@08:49).

From the investigation of email content (§ 6) we see that 55 % of emails from the corpus studied were specifically about the Project (rather than the Product or the Company) (Figure 6.1(a)). Within this set were identified portions specifically about contractually important topics: Cost (12%), Contracts (8%), Milestones or Deliverables (3%) and Risk (2%) (Figure 6.2). The relatively small number and their disproportionate importance emphasises the advantages of methods for associating emails within a common reference frame.

2) Capturing design intent

Engineering designers need to be able to understand the reasons why specific design features are present within a design, both for on-going work within a project and for retrospective reuse of a design. With the move to more distributed working these reasons are increasingly being communicated through asynchronous communication channels (e.g. email) rather than in meetings. It should be possible to use the communication record to better understand the intention of, and the rationale used by the original designers.

Evidence

Issue 18 identified emails as a source of design decisions that are not typically captured by established reporting systems or alternative reporting systems like DRed [85].

Issue 19 describes the importance of design artefacts in their roles as 'Objects of interaction' and the need to associate emails with these artefacts to allow engineers to understand how a particular email relates to the design as a whole.

The investigation of email content (§ 6) has shown that emails do contain information exchanged for the purposes of problem solving and that most of those emails concern searching and developing solutions (18 %) or presenting solutions (9 %) to problems. (§ 6.5)

Practicing engineers are aware of the problem of "losing design rationale... because they are buried in emails somewhere" (§ B.1@01:31), which they also know is at "the whim of the people as to whether they keep it, archive it [or] bin it" (§ B.1@03:10).

3) Traceability of contracts

In the course of exchanging email engineers can unwittingly guarantee a particular level of performance that then contractually binds the organisation without it being recorded within the contract. The project's Warranty Manager needs a way to track the development of contractual responsibilities, such as through identification of decisions points, as this allows the Company to understand, manage and defend its responsibilities during on-going relations with either their customers or suppliers.

Evidence

Understanding the trail of contractual responsibilities is necessary when warranty or service issues and other disputes arise and typically involve people who "haven't been involved with the day-to-day running" of the project and are therefore faced with a "great big database" and have to "find out what has happened over the previous couple of years" (§ B.4@02:56, § B.5@15:13).

In practice engineers rely on those who work directly on the project to locate the information they need through a "process of elimination, by running around the building and eventually... find[ing] out" where it is (§ B.5@15:13).

The investigation of email content (Chapter 6) showed that emails contain information about deadlines (16 %), deliveries (14 %), cost (12 %), contracts (8 %) and deliverables (3 %).

4) Auditing

Related to the need for traceability and for the visibility of design intent, the Organisation has a need for an auditable record of all communications to allow for the recovery of documents resulting from legal action. With one senior engineer stating that "email now has an important central role in contractual situations and is required evidence in any litigation where its content may be very important to establish design intention however unwittingly it was recorded". Failure to produce the evidence is not an option; therefore a low cost proactive effort to reduce a large future cost would be prudent.

Evidence

Issues 7 to 9, identified a lack of guidance from companies on how employees manage email retention, which was reinforced with findings from the survey (Chapter 7) that show just 14 % of engineers use a value based approach when considering the deletion of emails, 16 % delete emails either periodically or when they run out of storage space and 71 % of engineers reported they had received no training in the use of email (§ 7.3.4).

During the interviews an engineer described email retention as being at "the whim of the people as to whether they keep it, archive it [or] bin it" (§ B.1@03:10). Another

engineer highlighted the problem of "people [that] have then got private emails that haven't gone anywhere. So private emails I can't get at" (§ B.4@04:24) which is a problem because emails have "got to be discoverable" (§ B.4@04:49).

Additionally Issue 20 described how the problem of inconsistent retention is made more difficult in long-life projects where the engineers, tools and terminology change during the course of the project.

The relationship analysis study (Chapter 8) revealed an absence of records associated with the service phase of the project that was in turn found to be be the result of the service department maintaining a separate database of correspondence (§ 8.5.1), this is an example of the fragmentation of records which would impair auditing.

5) Facilitate shared understanding

All participants in a project, both within and outside the Company develop, during the course of the project, a shared understanding of the work carried out. This shared understanding is typically developed, maintained and recorded using conventional design artefacts, such as drawings and specifications, to act as boundary objects between participants. With the increase in the use of electronic communication to exchange valuable design information (separately from the traditional boundary objects) there is a need to make this information, such as the expression of risks that have being identified or on-going problems, more accessible to participants to improve shared understanding.

Evidence

Issue 19 describes how reference to boundary objects such as design and procedural artefacts are essential to effective communication and the development of shared understanding by the projects participants.

The investigation of email content (Chapter 6) showed that valuable information on risks and discussion of problems can be identified within the emails (§ 6.5).

The survey (Chapter 7) revealed that out of the 55 % of engineers that make use of categorisation only 15 % engineers make use of organisation level categorisation schemes and 6 % make use of project Information Systems leaving 34 % that perform the extra work of placing emails into folders but make use of non-standard categorisation scheme (§ 7.3.3) and which therefore do not contribute to the development of a shared understanding.

The development of shared understanding is also related to the development of communities of practice (Issue 12), which are organisation level groups that share interests and goals associated with a particular discipline or knowledge domain. Efforts to promote shared understanding will also be particularly beneficial in multi-disciplinary teams, that will tend to express ideas differently and have different expertise and backgrounds (Issue 15).

6) Ability to understand

email contain valuable information that can remain relevant through (and beyond) the life of long engineering projects (beyond the tenure of individual engineers) and this requires that they be understandable over long periods of time, across multiple disciplines and independent of changes in organisational structure and technology.

Evidence

From the study of email content (Chapter 6) we know that emails do contain valuable information (§ 6.5), and from the literature analysed in the relationship study (Chapter 8) it is seen that engineers effectiveness as information seekers is limited by familiarity with the content and categorisation of the Information System and that engineers use colleagues with more familiarity to aid searching (§ 8.1). In the interviews an engineer describes one of his tasks as being to "find out who agreed – should it be performing in this manner or that manner, and trying to find out where [...] is that information. And invariably I just go 'haven't got an idea' and I just go down and see the project director [... and] by a process of elimination [...] eventually you find out" (§ B.5@15:13).

However, as Issue 20 describes the barriers that affect the (re)use of information develop with time. The engineers involved with the project change company or retire, the tools and methodologies used for the design are developed, the stakeholder organisations are re-structured, merged or collapse, and the terminology that engineers use changes. Issue 15 elaborates on this theme, by identifying the difficulties associated with understanding across different professional disciplines.

In the email content study it was discussed that because of a lack of contextual information the coders had difficulty interpreting emails that were about topics that were unfamiliar to them (§ 6.5).

7) Understanding service patterns

As well as managing the correspondence between the different parties in a project, to be proactive, Service Engineers need to identify recurring problems in the Company's products. To achieve this they need to be able to see and interpret patterns in the problems being reported by customers and field engineers.

Evidence

The Derived (§ 3.2.2) set of issues described by the initial literature review are associated with studying patterns in emails and using the understanding gained to information organisational practice. During the interviews an engineer raised a similar issue, the need to "know you've got a repeat problem" for which they have "no method of ever search through", "so unless somebody remembers that that same vessel has a problem..." (§ B.5@31:02).

A complicating factor was identified in the relationship study (Chapter 8) where a fragmentation in the record between the main project documentation and the service department was identified (§ 8.5.1). In interviews with a service engineer, the fragmentation revealed to be worse still as "half the traffic probably is sitting in somebody's personal email box" because not everyone in the department uses their correspondence database (§ B.5@29:20). Unless a project has a consistent set of records then any effort to identify patterns within it would be of limited practicality.

9.2. Analysing the requirements

The requirements can be divided into those associated with the retrieval of email and those associated with the improving the understanding of email.

The retrieval requirements can be further described in terms of those associated with the retrieval of information by the content of the email as opposed to those that retrieve based on particular characteristics of the email. This is a well known distinction made in the classification field [86, pp.4-5] i.e., "known item retrieval" vs "subject retrieval" and it suggests the potential for using single established interventions to address multiple requirements. It also points to the application of existing solution 'types' to address the requirements, i.e. the use of classification to aid retrieval by the content of the email and the use of extended meta-data schemata to aid known item retrieval (§ 9.3.3).

The understanding requirements divide into those that support the understanding of an individual reusing email and those that explicitly extract organisational understanding from an email or collection of email. However, both types require the use of techniques to develop understanding from information as even explicit understanding requires the identification of topics and patterns of topic in the content of emails.

9.3. Proposals

9.3.1. Understanding from information

Requirements 1 and 2 identified (at their core) that the finding of emails by the particular features of their content (rather than by document characteristics) was required to improve the use of email in engineering.

It is proposed that the identification of the conceptual meaning of the content of emails and associated engineering documents, using established text-mining and semantic search techniques, will allow for relationships to be identified between email and documents that are relevant to each other; thereby reducing the fragmentation of information within a project [87, 88, 89].

Requirement 6 identified the need to support the interpretation of emails by those not directly familiar with the context of the project or organisation in which the email were authored. It is proposed that the core of the proposal put forward to meet Requirements 1 and 2 also addresses Requirement 6. The ability to interpret information is affected by the availability of sufficient context. It is proposed that context can be provided by identifying terms within the content of the email, associating the engineering documents that are most closely related to those terms and allowing an individual interpreting an email to see and follow those associations [90, 91].

Requirement 7 highlights an opportunity to use emails as a source of information for the identification of patterns in service issues. It is proposed that changing frequencies of occurrence of terms in emails (identified as described above) could provide insight into service patterns [43, 92].

9.3.2. Classification

Requirement 5 identifies the need to support the development of shared understanding of the communication carried out via email, particularly within projects dominated by email communication.

It is proposed that the application and use of a classification scheme will support the development of awareness and understanding through browsing, and the retrieval of specific information [33, 93].

The classification approach differs from object identification by making use of a formalised, browseable scheme, rather than a grounded collection of objects. The value/place of classification in information management is well established and a appropriate classification scheme for engineering email was developed as part of the email content study (Chapter 6).

9.3.3. Meta-data

To address requirements 3 and 4 there is a need to support the retrieval of documents by reference to document level descriptors beyond those supported by the email standard and traditional email clients. The requirements identify this need both in terms of a requirement for the purposes of auditing and a desirable to support integration of diverse and dispersed project teams. Although it is not possible to determine the exact characteristics required for either use case as the exact requirements of a specific audit or the particular support required will vary with each situation, it is possible to describe an extension to the standard email meta-data scheme that could support a range of uses. Such an extended meta-data scheme, specifically developed to support engineering documents, has already been produced by Lowe (2002) [20].

The meta-data proposal differs from the classification proposal as it supports "known item retrieval", rather than "subject" or "topic" retrieval, i.e., retrieval by the content of the document [86].

9.4. Summary

The aim of this chapter was to integrate the conclusions from the literature and investigative studies in order to summarise the requirements for improving the use and reuse of email to as records of engineering work, identify which requirements can be met using existing solutions, and which requirements need novel solutions. Addressing Research Question 4 (§ 4.2).

The chapter has described 7 requirements that have been developed using the evidence and understanding gained from the literature and investigative studies.

It has been shown how the requirements can be divided into two types, those primarily concerned with retrieval and those concerned with supporting understanding. And that the retrieval requirements can be further divided into those requiring known item retrieval and those requiring subject retrieval.

Sections 9.3.3 and 9.3.2 described how the retrieval requirements (5, 3 and 4) can be met using existing and established solutions. Section 9.3.1 described how requirements 1 and 2 can be addressed by applying concept identification techniques; and then described a novel approach for using the information gained from identifying the concepts in emails to address requirement 6. Chapter 10 describes an experiment that was conducted to investigate the implications of the proposed novel approach to requirement 6.

9.4.1. Contributions to knowledge

- 7 requirements synthesised from the issues discovered during the literature review and supported by understanding of gathered through the investigative studies

and interviews with practicing engineers. The requirements describe "critical instances" of the use and potential uses of email and enable effective communication of the challenges to the wider research community and industrial stakeholders. (§ 9.1)

- The proposal of approaches to meet requirements the requirements. (§ 9.3)
- The identification of 2 distinctions that can be used to describe email use requirements in engineering, whether a requirement requires understanding of the content of the emails and whether a requirement requires retrieval of the emails (§ 9.2).

10. Analysis of intervention to address Scenario 6

The scenario that this experiment aimed to mimic, is of supporting an engineer to (re)use valuable information held within project emails and specifically to interpret the content with respect to the wider project. The importance of this scenario was described in Section 9.3.1. An Hypothetico-Deductive approach was taken in the design of this experiment [94]. The hypothesis presented in the following section is based directly on this scenario.

10.0.2. Hypothesis

"Adding context available to the original authors of emails will improve the ability of other individuals to interpret those emails."

10.0.3. Predictions

The following testable predictions follow from the hypothesis. Where the Context group are participants provided with additional context and the No-treatment group are participants without it.

1. "The total scores of the Context group will be greater than those of the No-treatment group"
2. "The scores for questions requiring synthesis of information from multiple emails will be more substantially improved in the context group than their scores for questions requiring direct identification of concepts within the emails"

10.1. Design

The following sections describe the considerations taken when designing the experimental procedure. The independent variables affecting the experiment are described and the dependent variable used to measure the predictions is selected.

10.1.1. Variables

6 candidate independent and 1 measurable dependent variables were identified (see Table 10.1) as influencing or being influenced by the situation being investigated.

The following sections provide definitions of each of the variables and a description of how they will be treated in the experiment to test the predictions made above.

Independent	Dependent
Amount	Impact on ability to understand
Form	
Delivery	
Purpose	
Existing understanding	
Information	

Table 10.1.: Variables identified as being associated with testing the predictions.

Amount

The quantity of context provided. In terms of link density or length of abstracted text or number of annotations applied.

It is expected that this variable will have the strongest influence on the participants.

Form

The document structure and syntax used to present context, e.g., as hyperlinks to summary documents, as footnotes, as annotations or as abstracts.

In this experiment the form the context is represented in will not be varied. The context will be provided by hyperlinks to summary documents as this is a well established convention that should be familiar to all participants and additionally it was the approach used in a study of the affect of prior knowledge and working memory on the cognitive load in hypertext reading [95].

Delivery

The technical system used during the experiment, e.g., paper based, an electronic representation of the email, mock email client.

The effect of the system used for delivery is not of interest from the pragmatic perspective; it is largely established what engineering email systems will consist of and thus it will not be varied by the experiment.

What had to be considered, however, was the effect of changes to the participants routine and the novelty of the experimental program [96, p. 335].

Purpose

The type of problem that the participants are posed, e.g., tracing the rationale behind a design decision, identifying the party responsible for a warranty issue.

All participants were asked the same set of questions.

The questions the participants were posed were designed to require a combination of the identification of facts from within the single emails and to require the interpretation of information across multiple emails.

Experience

The level of education and career experience of the participant.

Due to limited availability participants had to include a mix of inexperienced students and highly experienced professional engineers.

This was controlled for by direct questions about the participants level of experience in the post-test interview.

Existing understanding

The level of familiarity with terminology and organisational practice.

Due to limited availability participants had to include a mix of inexperienced students and highly experienced professional engineers.

This was controlled for by selecting emails and questions that required no knowledge of the organisations involved, and with direct questions about the participants level of familiarity with the terminology and the organisations in the post-test interview.

Information

The information provided by the augmentation process.

The type, quality and semantic content of the information provided were controlled as part of the experimental setup.

Impact on ability to understand

The effect on the ability of the participant to comprehend and correctly interpret the set of email.

A single dependent variable was identified for measurement, how it was measured is discussed in Section 10.1.2.

10.1.2. Variation

In order to test the predictions a single variable – the Amount of context – provided to participants needed to be varied. As such the experiment participants were randomly divided into 2 groups, the Context group and the No-treatment group. The Form, Delivery, Purpose and Information variables were controlled through the experimental design and the Experience and Existing understanding variables were controlled for by direct questions in the post-test interview.

The metric for measuring the dependent variable was designed in advance of the experiment. The robustness of the measurement was improved by implementing multiple measures of the same variable. The different measurements targeted 2 perspectives of the variable, specifically an objective measurement of the participants actions during the experiment and a subjective measurement of the perception of the participants. The 2 measurements used were:

- Qualitative assessment of the participant's answers
- Direction questioning of the participant's perception of the test

The details of the measurements are provided in Sections 10.2.4 and 10.2.5 respectively.

10.1.3. Meta-evaluation

The following sections outline the steps taken in designing and conducting the experiment to ensure the results were accurate, reliable and repeatable.

Experimenter controls

A key factor could have influenced the way participants answered questions in the experiment and thereby affected the verisimilitude of experimental results was hypothesis awareness.

Hypothesis awareness is the condition in which participants having a genuine or imagined understanding of the expected outcome of an experiment, which then guides their behaviour [96, p. 226]; this is separate from effects resulting from knowledge of being a subject in an experiment (the Hawthorne effect, § 10.1.3). Hypothesis awareness was militated against by using software to control the presentation of information to participants and using a script to limit the variation during the interactions between the participant and the experimenter.

Placebo design

Any experiment occurs through some set of prescribed arrangement; it has been observed that participants will react to the arrangement of an experiment to the extent that it will affect the results (known as the Hawthorne effect) [96, p. 334], although the underlying mechanisms behind the Hawthorne effect are not well understood. A placebo is designed to mimic the experiment without altering any of the identified variables. The results from the placebo group then allow the results to be normalised for the effects of the experimental arrangement. As the variable was the provision of additional information it was satisfactory to use a "no treatment" group to serve as a placebo – in essence a normal control procedure, i.e., all other variables were maintained between the two treatment groups.

Deviant case analysis

In most sets of results there will be cases that do not support or contradict a pattern that is clearly visible in the data. When dealing with large sample sizes it is possible to demonstrate that these deviant cases are not statistically significant. With small sample sizes it is necessary to be able to identify and explain the factors that resulted in these deviant cases; thereby showing the cases not to be significant. This need to analyse deviant cases was considered in advance to ensure that sufficient information was available to facilitate an effective analysis. To do this variables that would normally be considered irrelevant had to be recorded; that presented an interesting challenge.

The approach taken in this experiment was to conduct interviews with the participants to develop an understanding of their experience and familiarity with the subject matter in the emails.

10.2. Method

Using the understanding of the variables identified, the variation chosen, the measurements required and the considerations given to meta-evaluation of the results the following procedure was designed to meet the requirements of the experiment. The methods employed for each step of the procedure are detailed in the following sections and were advised by a previous study of hypertext reading by DeStefano [95].

1. An example thread of emails where one of the main participants was still employed by the Company was identified
2. The emails were augmented in line with the variation (§ 10.1.2),

3. The participants took a Working Memory Test in-line
4. The augmented and original threads were presented to sample of engineers and a sample of design students using a standard email reading interface and they were asked to interpret the emails,
5. The participants then answered a series of questions based on their understanding of the emails,
6. The participants then completed a post-experiment interview,
7. and then the participants' answers to the questions were then assessed with reference to the answers provided by the employee involved in the thread.

10.2.1. Identifying and preparing emails

Identifying emails

A thread of emails was selected from the corpus of documents provided by the Industrial Partner for the work. The thread was chosen because it represented a concise discussion of a typical engineering change negotiation between engineers in the Industrial Partner, its customer and one supplier. The full thread of emails is available in Appendix C.

Making anonymous

Due to the sensitive nature of email correspondence the original corpus was made available on the basis that it would be kept confidential and all information published would be anonymised. As such, for those participants from outside the Company it was necessary to produce an anonymised set of emails. However, to ensure the emails remained readable and that anonymised entities (People and Organisations) could remain identifiable from one document to another it was necessary to replace their original names with pseudonyms rather than a more conventional approach of redacting the sensitive information.

The individuals mentioned within the material used in the experiment were made anonymous by consistently replacing their names' with pseudonyms[1].

The organisations mentioned were also made anonymous using a similar approach; however, pseudonyms were constructed so their characteristics were similar to those of the original names.

Object identification and description

In order to identify objects within the text requiring description, 2 coders not familiar with the corpus or domain used a grounded approach to identify the objects and unfamiliar themselves.

To ensure consistent identification of objects, once an object was identified in one email a stem of that object was used to search for other occurrences of the object. For multiple occurrences within a single document the common hypertext principle of just linking to the first occurrence was followed.

Once all the objects had been identified, factual descriptions were created for each object based on the domain knowledge of the Author, consultation with project documentation and discussions with the employees of the Company. No references or hyperlinks

[1]Generated using Fake Name Generator

to other documents or domain specific terms were included within the descriptions to limit the scope for variability in complexity and usefulness between descriptions [95]. The objects identified and the descriptions created are provided in Appendix E.

10.2.2. Working Memory Test

A Working Memory Test was used to control for the general reading ability of the individual participants (rather than self-reported levels) as well as the current mental state of the individual i.e. to account for hung-over students or fatigued engineers.

Measuring general reading ability has been identified as important for understanding the differences of individuals participating in studies of the cognitive load in hypertext reading [95]. Participants with Low WMs will perform less well than participants with High WMs.

An *operation span task* working memory test was used, following the procedure outlined by Engle [97]. This was used rather than a perhaps more directly appropriate *reading span task* due to the time constraints and the extra time required for the *reading span task*; research has suggested that both tasks effectively measure the same underlying cognitive function [98].

The operation span task consists of presenting (by means of a moving window) a set of equation and stimulus pairs to the user. The user is instructed to state whether the equation has been correctly evaluated and remember each associated stimulus until the end of the set; they are then instructed to recall the stimuli and their order within the set.

Items are presented by a moving window, with each component of the item being presented on a separate frame of the screen. This was implemented using a simple pdf presentation (see Figure 10.1 for an example of the presentation of an operation span task).

The stimuli used consisted of a pool of 1 syllable words spanning the vowel range, gleaned from a comprehensive word list [2].

The participants responses to the test are provided in full in Appendix D, the responses are summarised and analysed in the results section (§ 10.3.1).

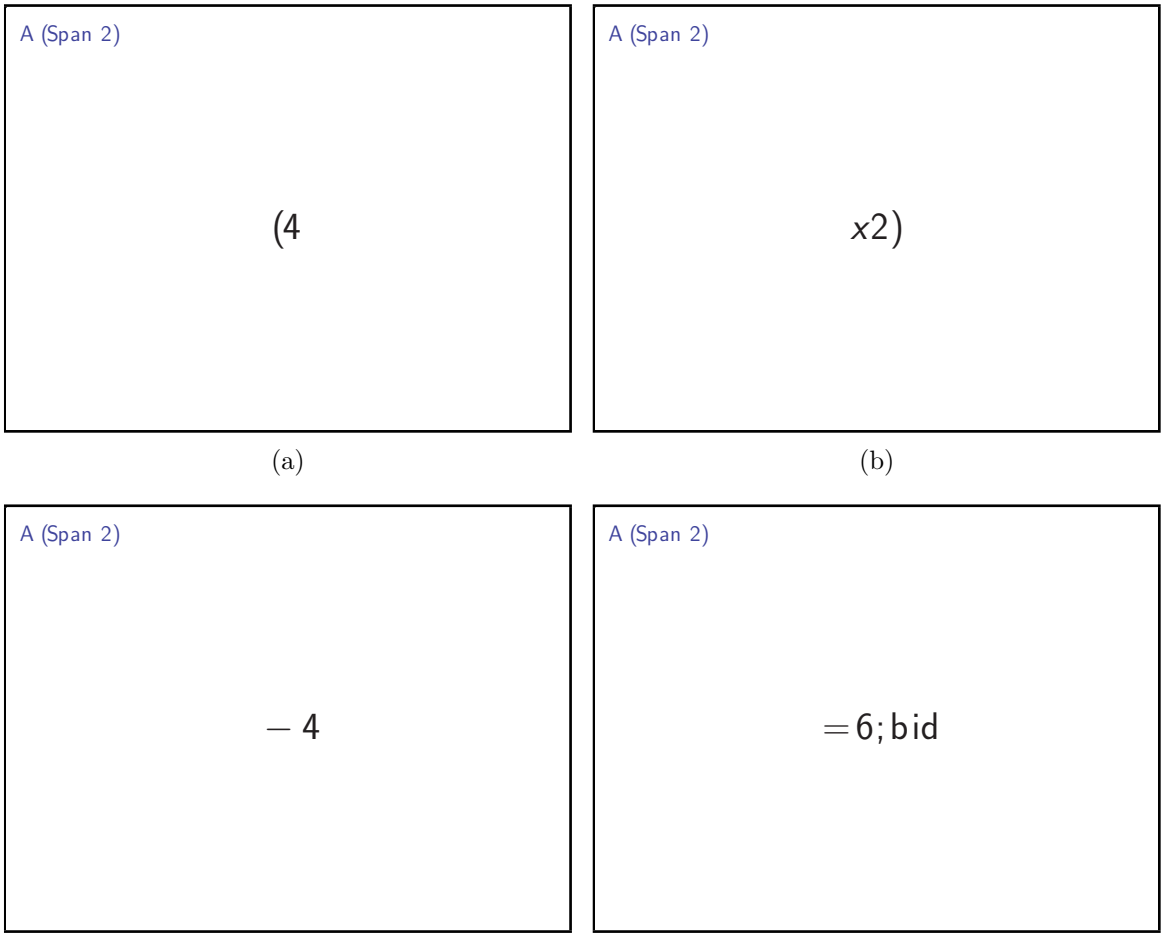
10.2.3. Presentation to participants

In line with the intention to control the independent variables Form and Delivery, the emails for both the Context group and the No-treatment group were presented through the same software interface.

The emails were presented through a standard email client [3] (See Figure 10.2). The emails were formatted as HTML emails to allow for the hyperlinks to the context documents to be inserted in the same way as conventional hypertext links, therefore the only difference between the experimental interface used by the Context group and that used by the No-treatment group was the presence of links within their emails.

The context documents were also formatted in HTML, when a participant clicked on a link to a given context document it was opened in a standard web browser [4] (See

[2] `http://ontrackreading.com/comprehensive-word-lists/vowel-sounds-1-syllable/`
[3] Mozilla Thunderbird
[4] Google Chrome



(a) (b) (c) (d)

Figure 10.1.: Example of one operation in the Operation Span Task, split over 4 windows. The participant would be presented with A, then B, C and D, in series.

Figure 10.3), with the content being served by a simple PHP script, running on a local server with Nginx and PHP-FPM.

10.2.4. Questions

To test Prediction 2, multiple questions were set for the participants. Question 1 tested their ability to summarise the factual information in the email thread as a whole. Question 2 tested their ability to extract information just about the change under discussion in the email thread. Questions 3 and 4 further tested their ability to extract factual information about very specific topics. Question 5 tested their ability to synthesise information across all the emails and use their understanding to comment on a significant difference between 2 emails in the thread. The questions presented to the participants are listed below:

1. Summarise the email thread, in less than 50 words?
2. Describe the final state of the change introduced?
3. Name and describe 3 key individuals within the thread?
4. Describe the responsibilities of the different organisations involved?
5. Discuss the difference between the final email from [X] and the final email from [X]?

Analysis of answers

Two approaches to the analysis of the answers provided by the participants were followed. First, the questions were answered by the individual who directed the project from which the emails were taken. His answers were used as the standard by which the others were marked. Second, a answer grounded qualitative coding was performed by a single coder.

Answers to questions 1, 2 were given a score out of 5, with 1 point being awarded for each correctly identified concept. Questions 3 and 4 were given a score out of 3, 1 point being awarded for each correctly identified and described person or company. Question 5 was also scored out of 3, with 1 point being awarded for each correctly identified concept. The correct concepts, people and companies are provided in Appendix F (§ F.1).

10.2.5. Post test interview

Post test interviews were conducted to control for the variable Experience in the participants and to test for hypothesis awareness. A semi-structured interview approach was used, with the interviews with students being directed by the following questions:

1. Which degree are you studying for?
2. Do you have any familiarity with hydraulics or power electronics?
3. Have you worked in industry?
4. How did you find the task?
5. Do you think you answered all of the questions satisfactorily?
6. Were there questions that were particularly difficult to answer?
7. Did you trust the information in the emails?

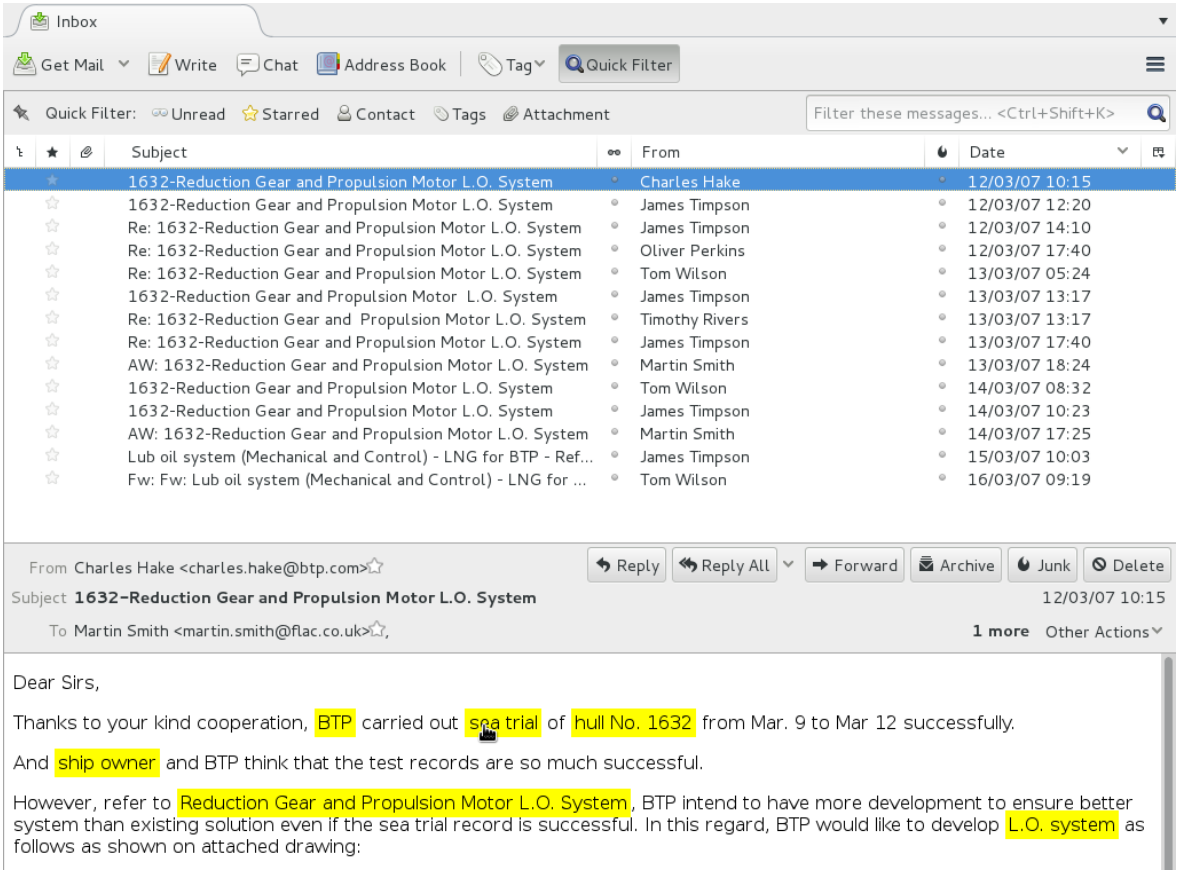


Figure 10.2.: The Thunderbird email client, used to present the emails to the participants, with one of the emails selected and displayed in the bottom pane.

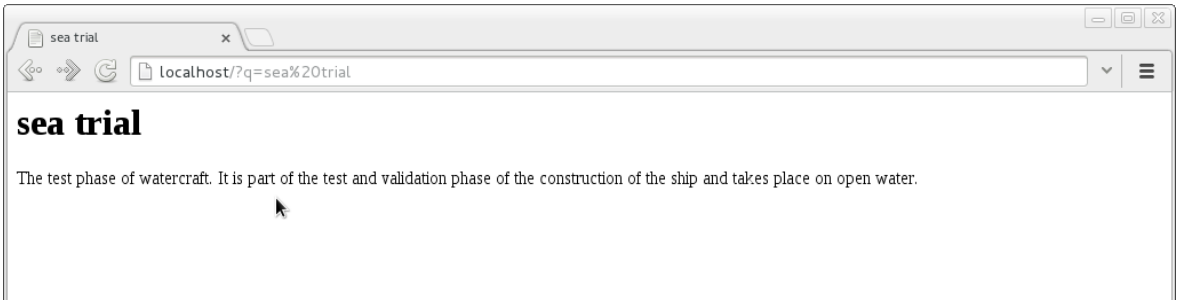


Figure 10.3.: The Google Chrome web browser, used to present the context documents to the participants, with the document for the term “sea trials” displayed.

Participant	WMS Score (%)	Answers Score (%)	Context provided
A	60	89	X
C	40	68	X
D	80	61	X
E	60	47	X
F	60	34	
G	60	42	
H	40	47	
L	80	58	
J	40	34	
K	100	55	
L	40	39	X
M	60	29	X
N	40	29	
O	60	100	X
P	40	84	X
Q	100	58	X
R	40	84	

Table 10.2.: The Working Memory Span and Answer scores for each participant, whether the participant was provided with Context is also indicated by the presence of an X.

8. During the test, did you come up with ideas for why I might be conducting this experiment?

The full transcripts of the post test interviews are available in Appendix B from Section B.7.

10.3. Results

10.3.1. Working Memory Span

From the answers to the check questions (see Appendix D) it is clear that all the participants decided to concentrate on just remembering the words, which would have resulted in high levels of errors in the check questions. Additionally, none of the participants were observed using short term memory techniques to improve their recall. From these 2 results we can infer that the participants took the exercise in good faith and that their answers when recalling the words are a genuine reflection of their performance in the test.

The normalised Working Memory Spans for each participant are presented in Table 10.2. The full responses to the Working Memory Span tests are available in Appendix D. The Working Memory Spans are plotted against the Answer scores in Figure 10.4, from which it can be seen that there is no clear correlation between a participants Working Memory Span and their ability to answer the questions. As there is no correlation evident the Working Memory Spans will not be part of the further analysis of the answers.

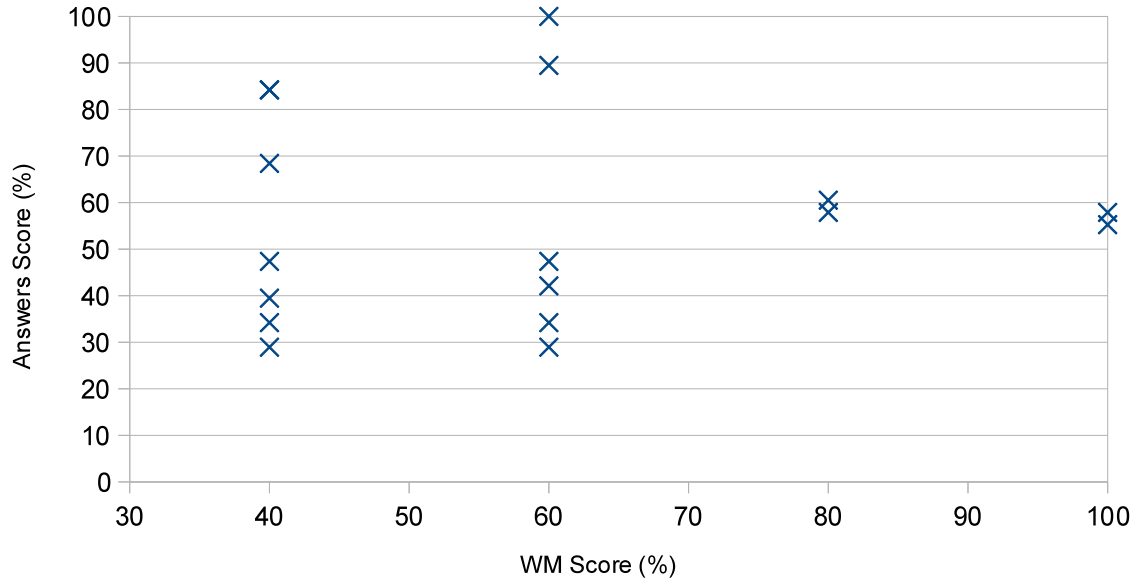


Figure 10.4.: Normalised Working Memory Spans against normalised Answer scores

10.3.2. Interpretation task

The full, transcribed, answers are available in Appendix F. The answers were analysed using the method described in Section 10.2.4. The total scores for each participant are presented in Table 10.2 and the scores for each participant on each question are presented in Figure 10.5.

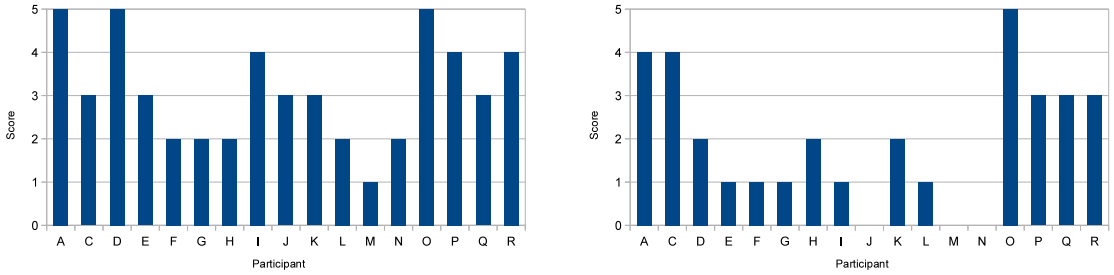
The average score across all the participants was 57 %. The average score for the Context group was 64 % and 48 % for the No-treatment group.

Participants N, O, P, Q and R were experienced engineers; they had an average score of 71 %, relative to an average of 50 % for those without experience. There are too few participants with experience to make claims about the effect of the provision of context on experienced engineers. However, the average score of the experienced engineers in the Context group was 81 % relative to 57 % in the No-treatment group, i.e., the effect of context provision was consistent with the effect across all the participants. The average score for participants without experience in the Context group was 56 % and 45 % for participants in the No-treatment group.

The average score for answers to Question 5 was low compared with the other questions at 27 % (Figure 10.5(e)). Participants in the Context group scored slightly higher than the No Treatment group, 30 % and 25 % respectively.

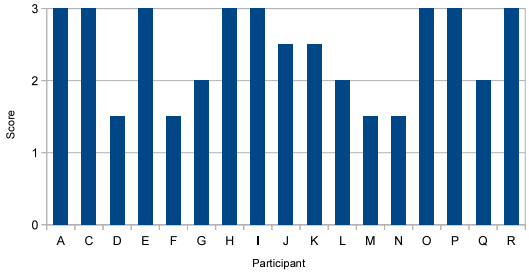
10.4. Conclusions

The results of the Working Memory Span test showed no evidence for a correlation with the participants' ability to answer the interpretation questions. This result suggests that future experiments on the topic of engineers' ability to interpret emails will not

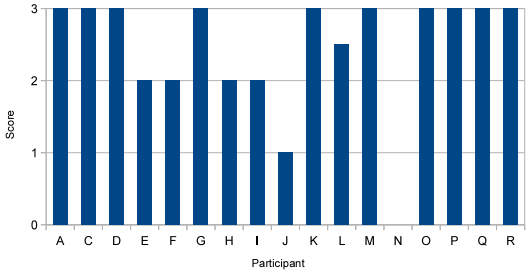


(a) Q1

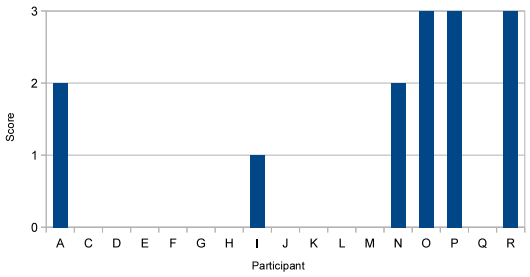
(b) Q2



(c) Q3



(d) Q4



(e) Q5

Figure 10.5.: The participants' individual scores for each question.

benefit from controlling for readability using the operation span task type of test for Working Memory Span.

The results of the Interpretation task clearly show that the provision of context to engineers improves their ability to interpret emails. Although this result is maintained for engineers with experience further experiments are needed to be able to establish this conclusively. Therefore, Prediction 1 is not disproved.

The results of the Interpretation task with respect to Prediction 2 are less clear, i.e., the answers to question 5. The results showed the same trend as for the other questions, i.e., that the Context group scored higher on average than the No Treatment group.

10.4.1. Contributions to knowledge

- Drawing on literature from the hypertext learning community designed an experimental procedure (§ 10.1) for assessing interventions to improve engineers' ability to interpret emails.
- Demonstrated the limitations of using operation span task for testing Working Memory Span for controlling for the reading ability in engineers (§ 10.3.1).
- Showed experimentally an effective intervention (§ 10.3.2) for improving the ability of engineers to interpret emails.

Part IV.

Conclusion

11. Conclusion

This chapter revisits the background for this research and reintroduces the research questions that were developed. In the context of those research questions the specific contributions to knowledge claimed are detailed. The potential areas for further research are highlighted and the recommendations to industry that stem from the research conducted are summarised.

11.1. Background

The use, reuse and manipulation of information has become a key factor in the success of any organisation in an increasingly competitive and global business environment. Ensuring that employees are able to access (or are provided with) the right information in a timely manner is one of the key challenges facing organisations. Communication is the process through which this timely provision is generally achieved. With the increasingly global economy engineering projects are becoming more geographically distributed. As a result of this, effective communication in some projects is increasingly difficult due to the distances, multiple locations and numerous participating organisations. Amongst the dominant communication methods email fills an important role in facilitating distributed communication and it is seen as a key target for improvement.

It was shown that email is being used extensively (and to an increasing extent) as a significant (and often dominant) method for communication within engineering organisations and projects and that there existed significant opportunity and requirement to improve the use and reuse of email. As the current practises for writing and distributing email do not result in comprehensive records of the work, that are intelligible to future users, or to automated processes.

The research aimed to develop a rich understanding of the use of email, the perception of email and the utility of information in email. This was achieved through an assessment of literature and the use of investigative studies. This understanding was then used to propose measures for improving email (re)use.

11.2. Research questions

From the rich understanding of the use of email and current engineering and information management practices 5 research questions were posed to structure the research around a set of clear and communicable goals.

1. What information is present in emails?

2. What are engineers' perceptions of email as a system and how do they use it?

3. How can email be used beyond its role as a communication system

4. What are the requirements for an email system that supports the (re)use of email as records?

5. How can email, as currently conceived, be improved and evaluated in this regard?

11.3. Contributions to knowledge

This thesis contributes a rich understanding of the practise and perception of email use and reuse developed through a comprehensive review of the literature and three investigative studies. A study of the content of emails exchanged during an engineering project, which found that the email corpus studied contained valuable reusable information, such as emails identifying risk and problem solving discussions, and that this information was not present in the projects documentation. A survey of practising engineers describing the role of email in supporting communication in projects and engineers perception of email, which found that engineers considered email to be a useful tool for communication, but were frustrated by the volume of email they received; it also found that the use of project specific categorisation was common. A final study investigated the potential for extracting the information about the relationships between engineers participating in a project from their exchanges of email.

The second main contribution is a set of scenarios that were developed to summarise the understanding developed in the investigative studies, and form a core set of contextualised problems that can be used to communicate the research to industry and around which an holistic proposal is described to improve engineers use and reuse of email.

The final main contribution is an approach for supporting engineers in interpreting emails by the provision of additional contextual information, mitigating a core problem identified during the course of the research for which a well established information management solution does not already exist.

The main contributions to knowledge are shown in association with the relevant research questions and Chapters on the following pages (Table 11.3).

Question	Chapter	Main findings
Q1	2	• Summarised the context of information management and communication in the engineering domain.
Q1	6	• Presented a detailed description of the content of emails from a real engineering project which is of use to future researchers in understanding email content. • Identified valuable information within the content of emails sourced from a real engineering project. • Found that much valuable information within emails is not present within other project documentation.
Q2	3	• 21 issues and opportunities were identified from the literature as underlying the research problem identified in the introduction, and as such describe in detail the problem space. • 3 themes that can be used to understand, in broad terms, the issues identified.

Question	Chapter	Main findings
Q2	7	• Collected and presented detailed responses from 89 individuals on their email practice and perception. • Identified a number of facets of engineers perception of email that are of direct benefit to Information System managers within Industry. • Identified that engineers appreciate the value of information stored in emails and regularly make use of old emails.
Q3	8	• Identified a disparity between the individuals represented in the email corpus and the individuals involved in the detailed project work. • Developed and described a method for analysing relationships between people within a project email corpus.

Question	Chapter	Main findings
Q4	9	• 7 scenarios synthesised from the issues discovered during the literature review and supported by understanding of gathered through the investigative studies and interviews with practicing engineers. The scenarios describe "critical instances" of the use and potential uses of email and enable effective communication of the challenges to the wider research community and industrial stakeholders. • The proposal of approaches to meet scenarios 5, 3 and 4. • The identification of 2 distinctions that can be used to describe email use scenarios in engineering, whether a scenario requires understanding of the content of the emails and whether a scenario requires retrieval of the emails.
Q5	10	• Drawing on literature from the hypertext learning community designed an experimental procedure for assessing interventions to improve engineers' ability to interpret emails. • Demonstrated the limitations of using operation span task for testing Working Memory Span for controlling for the reading ability in engineers. • Showed experimentally an effective intervention for improving the ability of engineers to interpret emails.

11.4. Further Research

The following sections describe specific avenues of research that may contribute to improving the (re)use of email that were identified during the course of this research but fell outside of the scope of this thesis.

11.4.1. Moving beyond email

Chapter 3 identified several issues that would be best tackled by moving communication away from email to tools specifically designed to support the needs of Engineers. Issue 18 identifies the importance of capturing the rationale used when making decisions, Issue 6 identifies the lack of relation between emails and the work processes they are authored with respect to, and Issue 10 identifies the lack of integration with project records generally.

From this it is evident that there would be value in further research to investigate the most effective approach for encouraging engineering companies to move away from email to more structured communications systems and the specific form these communication systems would take.

11.4.2. Software to identify objects within emails

To support the proposal outlined in Chapter 9 a comprehensive review examining the whole process of knowledge discovery and the specific application [99, p. 88] is required. There is an established 'Knowledge Discovery and Data-mining' (KDD) community that develops such systems using methods based on statistical, database and machine learning approaches [100, p. 10].

Specifically there is a need to investigate systems to practically support the identification of objects within emails, by automatically analysing the "complex, rich and opaque manner" in which text represents factual information [101]. The principle requirement is the need to identify text-mining approaches that aware of the concepts that are being expressed within the text [102, p. 807-808].

11.4.3. Email as a network

Chapter 3 identified 3 issues (12-14): Communities of practice, Expertise Mapping, and Spheres of Influence; that stress the importance of utilising the information embodied in collections of emails about the networks of individuals within a Company and its industrial partners. It is suggested that this is a potential avenue for further research as it offers organisations a way to improve their customer service by utilising a resource they already have access to, whilst also understanding the distribution of valuable knowledge within their organisation.

11.5. Recommendations to Industry

Despite the rapid growth of email, its widespread use, and many issues with how it is currently used, because it is seen as an informal and personal communication tool little emphasis is placed on it by the Information Management practitioners in engineering.

One of the main contributions of the research reported here has been to identify and distil a wide range of issues that affect the use of email in engineering. Chapter 3 identified 21 specific issues and Chapter 9 introduced 7 scenarios that describe critical instances of the use of email in engineering. The enthusiasm for improving the use of email shown by engineers when responding to the survey (Chapter 7) and the in the interviews suggests there would be value in communicating the issues identified to Information Management practitioners in industry.

Chapter 9 identifies the key requirements for improving the (re)use of email in the form of 3 broad proposals and the following points draw attention to particular issues that should be considered when implementing them in industry.

- **Review of issues** – In the current economic climate the authors appreciate there is little appetite in industry for initiatives which are not seen as directly adding value to a Company's offerings. With this in mind it is important for Information Management practitioners to review the issues presented here and identify those most affecting their Companies current practise.
- **Developing understanding from email** – As discussed in the section on further work (§ 11.4.2) the particular software systems for supporting the identification of objects in emails and relating them to documents have not been identified. It is suggested that Companies work with professionals from the Knowledge Discovery and Data-mining community to identify the best approach to suit their needs.
- **Use of a classification scheme** – The use of an organisation wide classification scheme was proposed (Chapter 9) to support the development of shared understanding. In order to minimise the disruption of introducing an unfamiliar classification scheme it would be necessary to review the Company's existing document classification
- **Use of an extended meta-data scheme** – The introduction of a custom meta-data schema based on work by Lowe, as proposed in Chapter 9 will require an analysis of what meta-data properties can be populated from a Company's existing Information Management systems and a tailoring of the terms used to match the terminology used in the Company.
- **Training of employees** – One of the key findings from the survey of engineers was the lack of Companies training their employees in communication skills and email use and the implications of the requirement for Companies' to retain email to manage contractual responsibilities.

12. List of Relevant Publications

Journal Papers

- Wasiak, J., Hicks, B., Newnes, L., Loftus, C., Dong, A. and Burrow, L., 2011. Managing by E-Mail: What E-mail Can Do for Engineering Project Management. IEEE Transactions on Engineering Management, 58 (3), pp. 445-456.

Conference Papers

- McAlpine, H.; Cash, P.; Howard, T.; Arikoglu, E. S.; Loftus, C.; O'Hare, J (2010). Key themes in design information management. In: Proceedings of the 11th International Design Conference, pp. 1595-1604.
- Loftus, C.; Hicks, B.J., McMahon, C.A. (2010). Understanding the use of email in engineering: A scenario based approach. In: Proceedings of the 11th International Design Conference, pp. 1575-1584.
- Ferri, C.; Jamshidi, J.; Loftus, C. and Maropoulos, P. (2010). Design of an information system for metrology contents. In: Proceedings of the 6th CIRP-Sponsored International Conference on Digital Enterprise Technology, pp.957-970. Springer Verlag.
- Loftus, C.; Hicks, B. and McMahon, C. (2009). How can we support engineering processes using semantic elements in emails. In European Conference on Computer Supported Cooperative Work, Vienna, Austria, 7-9 September 2009.
- Loftus, C.; Hicks, B. and McMahon, C. (2009). Capturing key relationships and stakeholders over the product lifecycle: an email based approach. In 6th International Conference on Project LifeCycle Management (PLM 09), Bath, UK, 6-8 July 2009.
- Loftus, C.; McMahon, C. and Hicks, B. (2008). Issues and challenges for improving email use in engineering design. In NordDesign 2008, pp.232 -242, Tallinn University of Technology, Tallinn, Estonia, August 21-23, 2008.

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Appendices

A. Survey questions

The following section structure is that used in the survey. Enumerated lists indicate an exclusive selection and an itemized list indicates an open selection.

As of 2009-09-25, the survey as presented to respondents can be found at:
`http://www.bath.ac.uk/idmrc/email-survey/`

A.1. Background

A.1.1. Personal

1. Select a role and an area to best describe your job?
   a) Director
   b) Manager
   c) Senior Engineer
   d) Engineer
   e) Supervisor
   f) Consultant
   g) Other (please specify)
   h) Skip question

   a) Administration and Support
   b) Design
   c) Manufacturing
   d) Research
   e) Service
   f) Software
   g) Other (please specify)
   h) Skip question
2. What age group are you in?
   a) 15-20
   b) 21-30
   c) 31-40
   d) 41-50
   e) 51-55

f) 56-60

g) 60+

h) Skip question

3. For how much of your day (in hours) do you use a computer, at work?

a) < 1

b) 1-2

c) 3-4

d) 5-6

e) 7-8

f) > 8

g) Skip question

4. For how much of your day (in hours) do you use email, at work?

a) < 1

b) 1-2

c) 3-4

d) 5-6

e) 7-8

f) > 8

g) Skip question

A.1.2. Organisation

5. What size is the organisation you are employed by?

- 1-9
- 10-49
- 50-249
- 250-499
- 500-999
- 1,000-4,999
- 5,000+
- Skip question

6. In which of the following sectors does the Organisation operate? (Select 1 or more)

- Basic metals
- Metal products
- Metals wholesale
- Mechanical equipment

- Electronics
- Electrical equipment
- Energy
- Environmental & Renewables
- Motor vehicles
- Aerospace
- Marine
- Other transport equipment
- Process industries
- Other (please specify)

7. Which regions does the Organisation, and it's customer base and supply chain, span? (Select 1 or more)

   Respondants were asked to report whether any of the follow were present for each of the different regions given in the 2nd list:

   - Company sites
   - Partners/Collaborators
   - Customer base
   - Supply chain
   - UK
   - Europe
   - N. America
   - S. America
   - Middle East
   - Asia Pacific
   - Central Asia
   - Africa
   - Other

A.1.3. Team

8. In which of the following ways do you work? (Select 1 or more)[1]
   - Individually
   - In a co-located team
   - In a internal team (distributed nationally)
   - In an internal team (distributed internationally)
   - In a multi-organisational team (distributed nationally)

[1]Used in Questions 10 and 15

- In a multi-organisational team (distributed internationally)

9. If applicable, what is the typical life of teams that you work in?
   a) Days
   b) Weeks
   c) Months
   d) Years
   e) Decades
   f) Indefinite
   g) Not applicable
10. For each group, how frequently is each communication method used?

    For each of the ways of working given in Question 8, the respondent was asked to report their usage frequency using the scale below against each of the following communication methods:

    - Email
    - Telephone
    - Fax
    - Instant messaging
    - Phone/Video conferences
    - Arranged meetings
    - Informal encounters

    a) Daily
    b) Weekly
    c) Monthly
    d) Yearly
    e) Never

A.2. Email

A.2.1. Use

In the following questions by 'spam' we refer to emails sent with malicious/nefarious intent by people external to your Organisation. We do not include unsolicited bulk emails. Such as, motivational emails sent out by your Human Resources department, no matter how tiresome they may be!

11. How many emails do you receive on a daily basis (not including spam)?[2]
12. How many emails do you send on a daily basis (not including spam)?[2]
13. How frequently do you check your emails at work?

[2]Free input

a) Never
b) Weekly
c) Daily
d) Hourly
e) On receiving an email
f) Skip question

14. What proportion of emails that you receive did you not need to receive?
    a) $< 10\%$
    b) 11-20%
    c) 21-40%
    d) 41-60%
    e) 61-80%
    f) $> 80\%$
    g) Skip question
15. How frequently does each group use emails for the activities below?

    For each of the ways of working given in Question 8, the respondent was asked to report their usage frequency using the scale below against each of the following activities:

    - Discussion
    - Making records
    - Task management
    - Document exchange
    - Drawing exchange
    - Arranging meetings
    - Customer relations
    - Admin

    a) Daily
    b) Weekly
    c) Monthly
    d) Yearly
    e) Never

A.2.2. Organising

The following questions refer only to your primary business account.

By archiving we mean the long term storage of emails. With at least the ability to search for and retrieve emails, if necessary.

16. How many emails are in your Inbox, currently?[2]

17. How many folders (or labels) do you use for storage/organisation?[2]
18. How many emails are currently available to you (not archived)?[2]

    The total number of emails across all your folders
19. Briefly describe your general strategy for managing email[3]

A.2.3. Reuse

20. How often do you find yourself unable to locate an email, to which you wish to refer?
    a) Daily
    b) Weekly
    c) Monthly
    d) Never
    e) Skip question
21. If known, what are the common root causes of being unable to locate an email (Select 1 or more)
    - The email was deleted
    - The email was miss filed
    - Poor recollection of key terms
    - Difficult to identify amongst a group of emails
22. My retention of email is restricted by storage capacity?
    a) Strongly agree
    b) Agree
    c) No opinion
    d) Disagree
    e) Strongly disagree
    f) Skip question
23. How often do you archive emails for future reference?
    a) Daily
    b) Weekly
    c) Monthly
    d) Never
    e) Skip question
24. How often do you refer to archived emails?
    a) Daily
    b) Weekly

[3] 8 lines of free-text input

c) Monthly

d) Never

e) Skip question

25. How often do you use email to remind you of events or tasks?

a) Daily

b) Weekly

c) Monthly

d) Never

e) Skip question

26. Who, primarily, controls the archiving of your emails?

a) Myself

b) My organisation

c) A delegated 3rd party organisation

d) No archiving is done

e) Skip question

A.2.4. Policy/Guidelines

27. Does your organisation have a policy for email use?

a) Yes

b) No

c) Do not know

d) Skip question

28. Have you received any training in email usage?

a) Yes

b) No

c) Skip question

29. Which of the following facilities does your organisation have? (Select 0 or more)

- Shared email accounts
- Customer relations management system
- Project Life-cycle management system
- General correspondence databases
- Central email search

30. How restrictive do you find the organisation's policies?

a) Very restrictive

b) Restrictive

c) Neutral

d) Enabling

e) Very enabling

f) Skip question

31. Do you, on balance, feel that email:[4]

We refer to email as a system, with both technical and behaviour aspects.

a) Increases stress – Decreases stress

b) Increases productivity – Decreases productivity

c) Creates pressure to respond – Gives time to think

d) Improves communication – Degrades communication

e) Is overused – Is underused

[4]The following items were presented as scale bars, with the extremes at each end.

B. Interview transcripts

B.1. Project Director

This is the transcript of an interview of [X] by James Wasiak and Craig Loftus with [X] observing. The interview was conducted on 2008-05-06 it is 36:17 in length and was transcribed by Craig Loftus on 2008-05-27.

B.1.1. Speaker key

C Craig Loftus (Bath)

J James Wasiak (Bath)

L [X]

M [X]

B.1.2. Transcript

L-00:01 I'm going to be in on this because I'm interested to see what you've got to say as well but also because I may be able to assist in some of the things they want to do.

M-00:09 Right.

J-00:12 Okay. Are you ready for 20 questions? I don't know where to kick off really.

M-00:22 Basically, just to give me a bit of background, You've looked at the [X] database which we've used on the BTP project, [X], yeah. Right okay. Now you've got-

C-00:34 Well we've been looking at it for a few days just trying to get- Well last week was just getting ourselves setup and getting the database and processing it so we can analyse it.

J-00:46 What we're trying to get out is a understanding generally of how email is used as a communication tool within [X]. Using this project as an example, so to kind of get a slightly higher level view if you like of- and kind of the implications that might have for future projects and communication. But then also to drill down into a bit of detail on it. We're trying to classify the emails and what kinds of information they contain. So what we'd really like is a bit of background to put things in context, because obviously from the emails you only really get a small snippet of the information.

C-01:24 So its the narrative to go with those emails, so that we can then fit them together and try and understand whats going on in the background.

M-01:30 Okay. Right-

L-01:31 And I'll just dip in just for a little bit of background as far as you're concerned [X]. I can't remember whether I've explained to you- I've got some fairly major knowledge management initiatives which are just starting and this is in a sense part of it. Fundamentally what we're looking at is, what processes do we carry out, what knowledge is involved and how can we make best use of it. Back in the dim and distant, [X] made a comment about [X], which was, they're losing design rationale, they don't know why decisions were made because they're buried in emails somewhere. So that was the initial driving force, but is a very pertinent point- With respect to- If we think about long-scale projects like [X], like the wind farms stuff, [X] and so on. How do we make sure we've got the right records, the right knowledge, right organisation and so on. So in the wider sense theres a whole raft of work which we're putting up- Which- Trying to get a coherent picture and obviously email is so dominant in what we do and we don't actually understand a lot about it dynamics really.

J-02:48 Theres a lot of anecdotal evidence for how people use it but we're trying to really substantiate it.

C-02:55 To some extent I think [X] is already in a 'not too bad' position in the way you do already have emails put into a centralised project database, its a first step. I know quite a lot of Companies don't do that.

M-03:10 Yeah. And its up the whim of the people as to whether they keep it, archive it, bin it. Right okay, fire away!

J-03:19 So, could you really give an overview of the project in terms of what the deliverables were, who the parties involved are (customer and teams within [X] if appropriate) and then just the timescales the projects gone through and rough costs, possibly.

M-03:38 Okay. Probably if you wanted one document to reference, early on in the engineering sections in the VPC, I think its the [X], somewhere around there in the engineering index in [X] is a project management plan. And there is also an organisation chart somewhere in there. Might not be in that document, might be in a separate one. That gives you overview of the project and the organisation structure that I'd set up to manage the job. But just for purpose of this, the project was awarded to us by BTP and it was initially for 4 [X] carriers, repeats. And subsequently we've got an order for another two, again they were supposed to be repeats. Repeats never are repeats but thats the intention. And the scope is-

C-04:33 So thats 2 and then 2 again?

M-04:34 4 and then 2 again

L-04:36 4 by 2

M-04:37 The scope is a lot of our standard hardware, or basic hardware should I say, might not be standard. The motors made over the road, converters, which were made by [X] or [X] and generators were over the road. Switchboards were [X]. So a lot of the power electronic equipment we made within the group. Transformers we bought from outside the group and things like the inverters or UPSes, they were bought outside the group. So we tried on this project to buy a lot of the big stuff inside and where we couldn't went outside with purchase orders.

L-05:28 Do you have any preferred supplier?

M-05:30 I think [X] is an example of a preferred supplied for switchboards. Long relationship there.

C-05:42 Were there any other major suppliers?

M-05:44 Those are really the bigs ones.

C-05:49 Sorry, is [X] a group-

M-05:51 [X] is an outside group, thats a transformer supplier. Based in [X]. You'll find on the transformer quite a bit of correspondence with [X]. Now, in order for us to manage this within the Company we actually split the management into 2, and I placed an internal order (consortium we called it) with [X]. And they really took responsibility for the power engineering. This is a little bit unusual, normally we'd take responsibility for everything, but we gave the Power Engineering responsibility to [X] and we retained the Automation and the Project Management responsibility here. The Automation is all the software and we developed quite a complex, sophisticated software system for controlling the cargo and the fuel gas pressure on these [X] tankers. So that was a high risk aspect of the project, nobody had ever done that before, and you'll probably see quite a bit on the management of that programme in its own right. Thats the software development for the- we said cargo and fuel gas system.

L-07:23 Are there distinct engineering groups either in [X] or [X]. That are, sort of, say- if we say [X] and [X] but within [X], does that break down into further internal groups, of significance or is it basically one team?

M-07:38 Yeah it does- we try to run the whole project as one team, but it was- [X] had a project manager who I would do the day to day liaison with and under him there was an engineering teams.

J-07:50 Who was that incidentally?

M-07:51 That was two people. It started off as being [X] and then became [X] and they had reporting to them an engineering group in [X]. And similarly here, I managed the project management, I had people supporting me commercially, but then I had an engineering team also reporting to me. And those two engineering teams were talking quite a bit, so you should see quite a lot of dialogue between the engineer reporting to Stephan which was [X] and [X]. In terms of communication-

C-08:44 Those are certainly names that we've come across-

M-08:49 So my line of communication was mostly with the customer and anything contractual then I would retain that link, if its commercial programme then I've got sole responsibility and you should see most correspondence between me and the customer. Not someone else in the Company and the Customer. Times of peak loading, you'll see me swamped and the engineers going direct but they should all be copying me. And the idea is that I retain the commercial control by knowing what is going on even if I'm not the direct line communicator.

J-09:25 So it was standard practice for them to carbon copy you into an email if they were speaking directly to the Company.

M-09:30 Yeah. Everything to the Customer I should have a carbon copy of so I know what is going on. And in commercial it goes through me butof late I've been

moving the commercial stuff more to [X] to try and get myself out of the project at this later stage. And get her picking up the ends, carrying on.

L-09:54 What is [X]'s role?

M-09:58 She is taking over control of the change proposals, management of parts that are missing on site and spares and things like that.

C-10:14 With you mentioning the other internal consortium, the group in [X]. Would they have a separate [X] database or is it all- should it all be in one database.

M-10:24 The original intention was that it was all one. And we had a meeting here and they were very happy with that but there were some problems. I think they didn't properly replicate it and we were on version 5 and they were on version 4 and they couldn't access files quickly. It was an internal problem, with getting it set up right. And actually they didn't use it very much at all. So, thats disappointing that. I was always pushing that angle, so a lot of- What should have happened is that they sent from [X] to me, what happened is they sent me an email and we had to put it in [X]. Which was-

C-11:06 So a lot of the time it would have ended up in [X] anyway. It just went through a more painful route.

M-11:10 Yes, exactly. Yeah.

L-11:13 I must ask you to have a look at [X] version 6 actually, which is supposed to assist this particular set of problems. [laughs]

L-11:24 But out of a different context. Yeah, this is a continuing problem, this sort of- Cross [X] seems more difficult than other things.

C-11:37 Is there anybody else you'd highlight as being key within the project. Other examples we've come across-

M-11:44 [X]

C-11:45 [X]. I was about to say the same thing!

M-11:48 Yeah, now [X] started off in a key role. We recognised that having the two engineers, one in [X] and one in [X]. One doing the power and one doing the automation was likely to create these two stove pipes and things fall in the middle. So, [X]'s brief was to try and make sure that the interfaces between these two things happened. And, so [X] did that. Now, sadly, [X] decided to join the customer of BTP, for more money. So you see him changing (@12:29) half way through the job.

C-12:32 We did notice that he suddenly- We'd gotten confused as to whether they were the same person or different people, with having a [X] email address.

M-12:40 Yeah, you're right, he swapped over. And another key role on this one was a design consultant [X] was KA- [X]! He came in as an outside consultant. He was given a [X] email address and he worked in a design office for us.

L-13:03 That was for top-side automation was it?

M-13:06 Thats right. To de-risk this new cargo gas control system. He helped write the specification for the engineers to code to.

L-13:22 So who took over [X]'s role internally, then?

M-13:24 [X] did.

L-13:26 Oh right, [X].

M-13:29 Yeah, this is a project which has suffered from by having almost every name change apart from mine I think. In the year of the people.

L-13:43 Yes, well there we go. Year of throw them all up in the air and see what happens.

J-13:49 Well that- This makes it interesting us for then because we've been looking- We've done some automation to look at the maps and the way email are being sent and the relationships between people. So its then a case of plotting them with respect to time and maybe interchanging certain people. Where two people might be filling the same role, but at the moment they would appear at different points in time on a diagram without time on they are two different places but actually they-

M-14:16 Yes, if you'd started- You've got [X] and [X] who are the two project managers at [X]. So they were the same role, so if you lumped all of them in. [X] was the engineer in [X] and I think up until very recently hes- For the analysis you're doing its only the last month or two that somebody else has moved in. [X] as I say has been replaced by [X] and who else is there. I think a lot of the other software engineers- Yeah, most other engineers are consistent. [X] has come in fair late doing deliveries and things like that.

L-15:03 Whats [X]'s background?

M-15:10 Well shes sort of grown up as a commercial assistant. Project assistant.

L-15:17 Yeah, thats what I understood. Thats why I was interested- She's taken quite a big role now.

M-15:23 Yeah, shes not sort of fully managing the project but she is certainly doing some key aspects for me. I've got to the point now where the new projects are coming in and I'm moving there and she's having to pick up-

L-15:37 So it might be quite interesting to talk to her.

M-15:42 Hmm, yeah. And the other aspect on this is the site work. There is a site manager, [X] and there should be- You should see quite a strong link between me and him in terms of correspondence?

J-15:57 Yes, we have done.

M-16:00 And then- I would say [X] is pretty poor at emails to be honest in terms of writing volumes. But he, yes, hes responsible for the site and the site team. Time-sheets and things like that- We've lots of issues with time-sheets not being signed, you'll probably find.

J-16:22 Haven't come across that yet.

C-16:23 Is that the site in [X]?

M-16:24 The site in [X], yeah. And then [X] is a quantity surveyor and hes been brought in, in the last 6 months to address commercial claims, you know, where they've not been paid or whether the customers wanted something more than he should have for the price.

L-16:48 Are you using [X]?

M-16:49 Yeah, but thats, that is very bad news I think. You need a lot of- [X] is going to do a review of that this week because we've got lots of things in [X] but not handled properly. Even the ship numbers- If they don't do a 198 you don't get the ships listed.

L-17:14 Nope. Right, okay, I don't want to digress. Although it may have some- I just wondered- The only reason I asked is that it may have linkages back into the email. Because [X] generates a lot of email. And if they are doing a lot of change management then you should see-

(@17:32)

M-17:31 Yeah, thats another database which is managing modifications. If there is a project change then the engineers should be recording it on [X] and it sends emails into the system. They actually go privately, I think they go to my inbox, not necessarily to the [X]-

L-17:54 Yes, they will go into your mailbox because up until very recently we've taken the strong view that [X] should never be a mail recipient because nobody would ever know that it was there [laughs]

M-18:06 Yeah

L-18:09 Version 6 has a slight variation on a theme, so that is one of the things I want to discuss with you. Anyway, thats- I don't want to distract this.

C-18:16 There were a few other names that we'd picked out (@18:19) seeming to come out key just from the network analysis. [X]?

M-18:26 [X], ah yeah. [X] is the lead engineer for the automation and he's, yeah, he's absolutely key. Anything to do with the control and the software, the automation processing, he- its [X] controlling that, managing that. And again, he's got quite a good link with the [X] engineer so there is quite a bit of correspondence going between the two of them. But again its the overall- If it is commercial and program it should come through me and I should be copied on those.

J-19:04 Which [X] engineer was that?

M-19:06 [X] or [X]. And the boss of them- So if you think them of them as, [X] was power engineer more closely allied to the [X] work and [X] as the automation engineer, more closely allied to the automation stuff that we do. And [X] is their boss and you'll find that little group of 3 is the detailed design team but in [X] they tend to leave the sales engineer in the project for the first, almost year. So yet get, I think it was [X], was their lead salesman, he stayed with the job well into the design phase and if there were any issues he was always there, always came up and the other person is the commercial man in BTP, who changes several times. [X] and there was someone else, theres been about 4 purchasing people on the job from [X]. [X] yeah. And then the chap who [X] (site engineer) liaised with was the commissioning engineer and thats [X]. That was the commissioning engineer who liaised with [X]. I think you've got the main players and the main links with who they were-

C-21:25 I think the only other named that popped out was [X].

M-21:30 Yeah, now, [X] did the initial job which [X] is doing, so some of the early supplies hes placing the orders with. He was doing a lot of work on trying to pull together suppliers, deliveries and things like that.

J-21:48 Did he leave the project. Was he replaced, in effect, by [X]?

M-21:53 He wasn't really officially replaced. His worked phased out because he'd placed all the orders and later on [X] picked up when it got near the delivery time for those suppliers. In the interim bit the engineers were dealing with the people on the-

L-22:16 So there was a peak of equipment ordering early on?

M-22:19 Yeah. Which [X] did.

L-22:21 Right. Then you've got the engineering, then you got the washing up and sorting out the detailed bits and bobs.

M-22:27 Getting the FATS, delivery, store shortages, is [X]. Yeah.

L-22:31 And now warranty?

M-22:34 Yeah. Right, now its gone into warranty. This is unusual in this job, because quite often if its a one ship job, when it gets to delivery to the end user its in warranty and the project team tends to move out. But on this job with there being 6 vessels. And 4- By the way, 4 of the vessels are for KA, 2 of the vessels are for [X]. Ultimately, they're all with BTP, but the first 4 were for KA and these last 2 are [X]. Different end users who could well have different end-user requirements but at the moment we're- 1 is in commercial operation, 1 is about to be delivered and the others are following on. So, thats where we are today.

C-23:29 On the KA front, theres an email address that came up, [X]? I think it seemed to-

M-23:37 [X] [pronounced], yes. Thats- When the ships are in service [X] is an automated email system that KA use to highlight where the ships is, where it will be in the next couple of ports or stop offs in order that people can coordinate getting bits on the ship or people and thats something that we're copied in on automatically 2 or 3 times a week. So you'll probably see loads of those.

C-24:11 Well it came out as a very strong subgroup on the network and that is because it obviously only strict emails to 5 people or something.

J-24:20 Does anyone send email to it?

M-24:23 No, its not.

C-24:25 Tell the ship where to be?! [laughs] ()

L-24:29 Right, thats how they synchronise the logistics between suppliers and the ship. Ah thats interesting. Would that automatically get routed to a particular person within our organisation?

M-24:38 It does to, as you said, about 4 or 5 people, and I think its really- [X] is the person who is responsible for service. Thats what I was saying, we've got 6 ships, 1 is in service and on this job [X] has picked up from a service point of view that vessel and he is managing for me all the warranty issues.

L-25:04 Now, tell me something just- I'm not sure this is terribly important as far as these guys are concerned but warranty is part of the project not part of service normally, thats right isn't it?

M-25:13 Yeah, thats right. I hold the warranty part as part of my project funding and-

L-25:21 So you're basically just employing [X] as a subcontractor. [laughs] I'm sure nobody would like that.

M-25:26 That is more or less what has happened there.

L-25:28 Okay, fair enough. So when it reaches end of warranty will it go into service? What happens then?

M-25:37 Its officially in service now.

L-25:40 I mean- Sorry- I meant into our service organisation.

M-25:42 Yeah, thats why I think on this one we've done it right because we've employed [X] now and service department are starting to build up knowledge on that vessel before we get a fleet on them.

L-25:56 Yeah, okay. And all the email for warranty does that go into [X]

M-26:01 Yes, [X] is encouraged to do that. (@26:05)

J-26:05 There were emails being sent in to [X] until last Wednesday. So- somethings got in there.

L-26:12 Did you see theres a- theres something which isn't- Well, might be relevant because if you have a chance to look at the correspondence database. Because service will typically use the correspondence database to manage all their correspondence. Unfortunately thats a little bit orthogonal to the concept of using [X] and we haven't quite got to the resolution of that yet. But I think [X] from my point of view, might be the one that I try to push it on. Just because I think, you know, you've done a great job in keeping it all together there. It would very very sensible in my view, but others may differ, to keep it going.

M-26:47 Service to maintain their bit. I'm sure [X] sees some benefit in being able to go back into the [X] database and find other project related data.

L-26:58 From the point of view of your ultimate directions and my interest in long term management of knowledge and recognising that a lot of the information is actually in email- This is where it comes together as far as I'm concerned. And in the end is what [X] is sort of doing. [X] is another guy who is working here, he's one of the two knowledge management partners. He's actually looking at how service handle customer incident- Comes through the message answering service. Actually looking at the process, where do they get the information from? In my simplistic world, his primary port of call in may cases should be [X] but of course at the moment that is not realistic in a lot of situations. Anyway, so starting (@27:46) to form a picture.

M-27:48 Right. I've got to zip off somewhere so if I've not covered all your points yet I don't think.

C-27:54 Just touching on something we were already talking about just now, you say you- You've said several times that you encourage people to use [X]. I was wondering how- If you have particular policies, or just how strongly you do encourage. If you have team meetings where you stand up and shout at them to use [X]?

M-28:13 When we start the project it is more than encourage. "This will be the tool that we will use, won't it" [taps finger on table]. So we start from that basis and the encouragement is needed when you see people lapsing or putting things onto the J Drive. And I've just told [X] on my new project, I said "Do not put a project file on the J Drive, I want it removed". Just to make sure they put it here, not two places. And the other thing with the J Drive, when I'm away with my laptop or one of the engineers is away, you don't have a replica of the J Drive.

C-28:51 The J Drive is just a software-

L-28:55 Its a contracts server.

M-28:56 One of our servers. Yeah.

J-28:58 So is there any, kind of, formal practice for what would be considered useful to put in [X] and what isn't. Because obviously you don't want copying their entire inbox into [X] or should they be?

M-29:08 I've- If its related to the project and its an email from somebody to the project, then I'm encouraging them to put it in.

J-29:17 And its totally at their discretion as to whats- To categorise what is to do with the project and what is-

M-29:22 I think- Yeah. If its got the project name on it or its an issue effecting the project it should go in. So it is- Its almost any email referencing the project, it should be in there. And where that becomes really valuable is when you get like [X] doing claims. If you talk to him you'll find his ability to trawl through correspondence and build up a legal case for- You know, not litigation but legal case to argue.

L-29:59 Getting payment. So whats his role? His role is basically-

M-30:05 He is a quantity surveyor and his role is to pursue contractual or commercial issues.

C-30:15 It would be very interesting to talk to him if he's using correspondence as that sort of source.

L-30:23 Yes, thats an interesting- I hadn't thought of that one, because we've tended to focus more on the technical content of documents shall we say but the commercial side is just as important. And it comes together in [X] and that was the original justification for [X]. Perhaps we should integrate [X] with [X]? Oh, I'm only joking. I wouldn't dream of it.

L-31:34 One of the things I'm interested in is trying to understand the boundaries of groups of people, but when you've only got one person like [X]- I assume more or less-

M-31:40 Well he did have a team with him.

L-31:44 Did he? Whose the key people?

M-31:46 [X], [X] and then hes got some of the other software engineers that work for [X].

L-32:09 Ah yes, of course. Yeah, okay.

M-32:12 Are also in that team. [X] and [X].

L-32:18 Okay. Just one of the interesting things here is that- One of the things I want to try and get a handle on is our understanding of what the group boundaries are in the Company. Because one of the difficulties I perceive is that theres still quite strong barriers/boundaries. So one of the things that the analysis might reveal, I'm not sure that it will, but it might reveal is more information about what information passes those boundaries because if we can get a handle on that, that might help us on how we cooperate. Because one of the other threads of work thats going on, thats not strictly related to this but its about basically, what I call the social networking of experts. Basically who knows what, who knows who knows what and how do you get in contact and what do you find. Its that process and again, I think [X] is very useful in this particularly because it gives you some linkage into email.

M-33:17 Theres another interesting angle to this is that I was co-located to the area where the software engineering was done, which was a high risk activity. So I sat with [X] and [X] and that team and there was a lot of communication, sort of, you could hear what was going on all the time, the dynamics of that was completely different. I'm down here and they're up there.

L-33:47 Thats why you were sitting up there? I did wonder, I never actually got around to asking you.

M-33:53 Yeah, it was very good. And you talk to the engineers.

L-33:54 How long were you up there?

M-33:55 A couple of years. The engineers said that was brilliant.

L-33:59 Interesting. That is very interesting. Okay.

M-34:03 Because they hear whats going on commercially. It reminds them theres variations and changes going on-

C-34:10 So was your engineering team up there with the software engineers as well and yourself? You were all co-located in the same room?

M-34:16 Yeah, there was [X] who was the lead engineer, [X] and then the software team. That was the area.

L-34:25 Because traditionally there is quite a boundary between the power system engineers and the automation engineers. I don't know whether that was true in?

M-34:33 Yeah it was because [X] developed-

L-34:35 Oh yeah, because [X] would have taken the-

M-34:37 [X] was trying to bring it together.

C-34:40 I was just wondering on the point of barriers again, how it worked with communication with [X], if it all went through the lead engineers or if there was lower down as well?

M-34:52 I'd say 80% of it was through the lead engineer and myself, with [X]. Should be. Interesting thread there when you do your analysis.

L-35:00 And what about BTP? Are they- Whats their style of relationship with us? Is it hands off or closely integrated or?

M-35:13 You'll find they have management meetings with their directors every other- Or the managers have meetings with the directors twice a week and you quite often find that as a result of that, you'll get things coming out of that meeting and the engineers- The younger engineers will absolutely panic. "Top urgent", "Top, top urgent", "Must have reply tomorrow". And its usually driven from that top level meeting and quite often you sit there thinking "Why do they want that?". And its just this very- The power base is really high up in BTP and where as here we try and move the power base down a little bit by saying to engineers you've got delegated- You delegated to sort that job out. There you'll be given tasks. Okay!

B.2. Project Secretary

This is the transcript of an interview of [X] by James Wasiak. The interview was conducted on 2008-05-08 it is 35:30 in length and was transcribed by James Wasiak on 2008-05-21.

B.2.1. Speaker key

J James Wasiak (Bath)

T [X] – Project Secretary (CVT)

B.2.2. Transcript

J and you've dealt with quite a lot of correspondence

T Too much, that's the problem with our emails no err- it's a busy project, that particular project anyway, yeah it's quite busy with emails anyway. Because with that project we're dealing with erm two ships yards as well–so you've two lots of customers, two lots of site teams to deal with, and we're dealing with a local [X] office as well – so there's a lot of emails there.

J How much of your day do you think you spend-?

T Too long

J Too long

T Far too long, and it err, gets in the way of actually being able to do work. We're actually out there trying to (there's me and another project manager) we're everyday trying to come up with a better way of dealing with them.

J Right, that is interesting an interesting thing to hear first hand, it is a serious situation-

T Everyday we come up and we spend a terrible lot of time on just looking through emails and the problem is because you're looking through them you're not erm- actually doing anything about what the emails are about, coz obviously its taken

time to look through. I think the problem on this particular project is erm- because we sometimes have two and three people following the same information, but because I'm not sure if it's actually about the same issue I have to open each email to make sure.

J Right, so you're dealing with-

T So it's like three times the work really.

J Ok, that's good, that's interesting. So obviously we try to think is email an effective way of dealing with things, because people can say "I spend all day dealing with email, but if they've managed to achieve all their work through email then, it-

T It's good, and it has got good points to it. Erm. But I, in a work situation I've never worked with anything except Lotus notes, but we have had other people who've come in from outside and said "it's one of the worst packages you could possibly use!" That's not my- I don't know, I can't compare to- I mean the one before Lotus notes I used was word perfect so I can't, you know, but people are saying like searching and different things.

J So do you use email mostly for responding to other people's queries and questions, or is it more that you drive emails out, you'll start an email from scratch.

T Both- yeah it's about the same, both, we do a lot if replying, the problem, I think the problem-because this project is obviously about [X], so we're dealing with [X] and their culture is they want answers too, but they want a reply to your email just to tell them that you've actually seen their email and you're dealing with it. Whereas in our culture we try and do something about it and then send the email. So obviously if they're not getting replies straight away they think they're being ignored. So now what we have to do is send them an email to say "I'm dealing with this – I'll get back to you tomorrow". It isn't always feasible, a lot of the time we let them down because we can't find the time to go and do that while we're replying to emails so- I don't I only email where I have to, I won't email if I can help it and I don't email to everyone in the company.

J So do you pick up the phone instead or-

T Yeah I pick up the phone, or I'll actually walk and see somebody. I mean if I have an issue with an engineer upstairs, I'll go upstairs and try to sort it out that way.

J That's what I prefer to do actually,

T We do a mixture and I think you need to do that in order to build up a good relationship with your engineers. Really.

J On the subject of the [X], I noticed some of the language in the emails was quite different, did you find actually communication difficulties with understanding their English,

T No not really, I think though erm-.I know it's on this particular project because we're dealing with two ship yards, one ship yard is a lot better with understanding English than the other ship yard. Erm-there haven't been really that many-that major-where I didn't understand, or they didn't understand, there might be an odd bit but no different than here. I didn't think it was really a problem.

J When I look at the email it can be quite obscure because there's technical information I'm not familiar with the project, so it's like how much does this actually make sense to someone else -

T I think as long as you know who's dealing with certain bits / parts of what we're supplying Engineering wise I suppose. Yeah it wouldn't make any sense- () you just look at the email.

J OK, I think I've touched on what I wanted to for the beginning part, I've got lots of questions written down of which I think I know the answers to, you email lots of people from outside [X], more, people in the office as well.

T I try to keep people in the office to a limit, only because, we end up with loads of emails, so I try to cut down my emails as best I can, but obviously there's cases where you have to-where there's-we have a lot of stuff where we have to attach documents to be looked at, or drawings or whatever so it's a lot quicker and faster to use email,

J Do you use email rather than any file sharing?

T To try and go and print out a drawing or go and find it -it's erm. +

J Good, I've got a question here which says, "would you describe the role you played in the project" and I guess I've got a fair idea, but would you just put into your own words for me, I guess: what you feel your job is-

T OK, I err, support the project director on the project he's erm, I suppose it's a commercial engineering role really, but erm, organizing shipments, and any problems on site really. It's difficult to just say because, each day is just- but it's the role of commercial engineer; really.

J Is that the role title?

T Yeah

J () I didn't have that, written down before, just to help build up background for if we talk about things in a paper, like what peoples understanding of things are to be able to place you-

T Yeah I mean err, I suppose it's really project support to the project director and erm, the site team, and our customer as well.

J That's what I'd picked up from the emails I'd read, it sounds like a lot of hard work!

T There's just not enough time in the day, the problem is it's not the only project I'm working on.

J Right

T So we have a time (), it's quite a busy project, it's a very busy project, so it's just trying to fit everything into- () my work.

J So there were 16000 emails in [X],

T () God

J That's over four years,

T But I also think our [X] database is not erm, as efficient as it could be. Personally -.I think-. It would be busy with emails, but I think erm, the organization of the database itself. Because with [X], everybody is using it differently, and it's

not always easy to look at it and define where something should go. If you look at it, the customer, and that's just an example, then you have a third party customer, so it's not always err, but I think that -we'd started using [X] but I think that when that project came along, people weren't really using it, and we started using it and weren't really sure, And people just opened folders all over the place just to put stuff in. And I believe and I hope now, that our new project will be a lot tidier in the way-

J So, do you think [X] is the right way to do things, it just needs to be better managed.

T I think it needs to be better managed but I think it also–there's search problems-. [Tea lady enters]

T Would you like a cup of tea or coffee?

J No thanks, I've just had one actually,

T and+ I think what has happened with [X] like, we have lotus notes, which obviously [X] is worked off, we have to move stuff from Lotus Notes into [X], because we're not- the facility isn't there to solely use [X] on its own. So it's like double the work really, moving it from there into [X].

J Right so it would be easier if you could just-

T So if you could sort of have it where you could also work just from [X] I think it would make life a lot easier for everybody. [Tea lady talks then leaves]

T I think that if, some of it is err documents, and we have to go out on to a main drive and then move them into [X] into corresponding, and then, I think it just needs tightening up a little bit. Maybe, I don't know what the answer is. I have actually had this conversation with a few people in the company and the guy who actually sets up our project database, [X], I have said to him " can we not standardize it in such a way that because there's one folder in [X] which is called general, and I hate it!! Because everybody puts everything in general!

J Will I see this in the [X] database that I've got, the [X]-

T If you go into [X] there's probably general in quite a few places. In that database alone. And because there's been a lot of emails it's not like you can move them, open a folder and start a fresh, you know try- a quick process

J It's just too much,

T Yeah

J Mm I understand that, you said that it was [X] who sets-

T Well when we have a project he sets the database up for each project and he talks to the project manager and says which folders they want setting up and - a lot of it's the sub folders really that people set up, and as I say they're not sure how to use it and they're not sure what they should be putting in there really.

J We have had a brief look inside, just to pluck out all the stuff we wanted for our analysis, to put into our software we use to mark stuff up and extract it, and just five minutes looking inside there made me -

T So that's 16,000 emails in the database,

J In the general correspondence for the [X]

T That's just correspondence,

J Just correspondence [stunned silence]

J So yeah 16000 emails, so I don't know how many faxes and other bit there are stored in there as well.

T Because we store engineering documents in there, we store obviously financial stuff as well. [Still shocked]

J Yeah, a lot, erm- you're very good to speak to, most of the stuff I think I want to know I'm getting and that's useful, certainly your feelings on [X] and your problems with email. Because I think it definitely is a problem (I think so)

T You see, we need to find a way, what we need out there is to find a way to save time on lots of stuff because obviously the time you spend on emails- () should we look at it once a day, twice a day, should we look at it in the morning? and then again in the afternoon? Would that work or-.should we not open it until 10 o clock in the morning? Do you know what I mean err-? Because it's not really possible to look at it just in the morning, first thing in the morning, in a way, coz we've time difference, we've [X] jobs, we've [X] jobs, we've [X] jobs, [X], so it's not-coz of the time difference, like when at first we were just working on [X] jobs it was great, coz you had the morning to look after, then they'd start again in the afternoon, so if you come in the morning, they've done all their bits and you've the morning to deal with it, and then it starts again in the afternoon. But because you're now- + and the [X], I don't think they ever sleep!! At least it doesn't seem that way. Erm, coz you get emails from them all times of the day, so erm. But I don't know what the solution is but I think we do need to do something, to be able to manage it efficiently.

J Ok. Erm, one of the things I wanted to do was ask stuff which although I probably already know about from looking at the database, but what I wanted to see is what you think is in there compared with what you actually think is in there, and what you think email is used for compared with what we think it's used for () and to see whether we agree. Some of the questions are-what kind of tasks do you think you use emails for, so what kind of things is it helping, or not helping you with?

T Erm. It does help if you have to go back and trace back- it helps with site activities, if erm, commissioning activities if you have to trace anything back. Erm- + I'm just trying to think of the best way to put this- there is a lot of stuff that it does help you with, erm++ but I think there may be a problem with the search bit, which doesn't make it easy for you to find certain information. Erm, But yeah I think it's very helpful for correspondence with the customer, the suppliers, financial information. But that's all down to the user as well, if the stuff isn't put in there, because we have to physically put a lot of stuff in there, if it's not put in there it's really of no use.

J And is there a consistent practice across [X] or across this site for how to deal with email. Has any one ever told you: "This is how you should organize things? This is how you should use [X]?"

T Not really no, they did do courses and then- I'd been using it for a long time, and then I asked about having a re-familiarization really. But I think that everybody

is doing their own thing, () not their own thing, but not everybody is using it in the same way, and hence why there's lots of rubbish in there. Some parts are consistent, but I think it definitely needs improving.

J So you're- if there was one thing you could say- can you think how it would need improving, or just that it does. The integration of lotus notes with [X]?

T I think the integration of lotus notes with [X] would save a lot of time an effort if-.you-.it's supposed to be an information database for projects, each project should have it's own [X] database- + and why can't we have just that? Why do we have to duplicate stuff-twice the effort, especially in the busy environment at the moment.

J And do you feel you would rather be using something else than email, if there was another choice out there to communicate with customers,

T Well I don't know of / if there's any other thing you could possibly have-

J Say 20 years ago, obviously in Engineering offices email (which was just kicking off) wasn't used.

T Yeah – but I suppose it's a busier world now, and we're dealing with people-especially I think for [X] we've become a global company now, where as I suppose erm, 20 years ago we had a lot of UK business I suppose. The demand wasn't there to meet all these different time zones- so I don't know if there is (another communication tool) so I think you have to have email,

J You have to have email?

T I definitely think, yeah, and I err, I have seen situations, even today, where if we hadn't had email -how quick we've got responses back to deal with a problem, as a result of having email.

J Do you find people are actually quite quick to respond to their email?

T Not always no, not always, sometimes but no, not always+ I find sometimes customers are, their problems with their internal responses are not so quick. And when I say internal I mean like the [X] internal company. But you'd probably get that if you sent them a fax you know, I don't think that's the email. That's those people,

J That's the working practices?

T Yeah, they () anyway.

J Ok, that's been really helpful, I'm trying to think if I've got anymore to ask, but I think we're -I think really we've covered most of that [points to question sheet]-.

T And someone else will say "it's great, it's absolutely fantastic"

J I wonder, I wonder, I don't think they will, but I don't know. Finding the solution is a bit more difficult.

T So have you, come in to check the information that was the example of what you should use? To check it out? Which it is, that database on that project of [X] is a good, because it's quite a big project and it was quite a big team working on it as well here so you would have loads of email and what have you. But erm, is it just the [X] side of it or is it the databases you're looking at, within the company?

J We're not looking at anything else within the company, outside of [X], at the University, academically what we're looking at is the fact that everyone uses email, all the companies use email, but at their ends they do completely different thing, and no one really knows, legally: whether they should be keeping stuff, deleting it,

T Yeah that's

J What bits they should be keeping. One of the things that we're interested in is reuse of information, we think that there is a lot of important design information that goes into the emails that isn't getting recorded elsewhere, at [X] the emails tend to be going into [X], but whether that is retrievable information for future projects. So we're also looking at it from that kind of perspective.

T But engineering, they should have separate places just for the documents on [X], you know there's an engineering section in there, project implementation, and all the design specification, all that should be there as separate documents. Even if it's attached from the email somewhere else. But I think some of the problems there is, if people aren't sure if someone else is detaching it-the attachments, so you can then end up with all these different-seven people receive an email with an attachement in [X], you end up with those 7 emails put in [X], and I don't know how you control that because you're going to have to control that by saying make sure one person always gets every email sent out to the company and that one person always puts it in. I mean we've we did a [X] course in January and they actually, there was a role on the project called the information co-ordinator, and they coordinate everything and they tag everything electronically. And maybe that's the way to go, you copy it in, you copy emails wherever but this one person is responsible for putting them into this particular database, I don't know really.

J Did you do some sorting of some stuff, some tagging of stuff, some marking up information, did you file anyone else's correspondence?

T No, with some of them yesterday I started where we'd send a variation out to the customer, and I'd put a link in of, I'd put a document there-a particular document there called a change proposal. So I'd put that document in [X], but in the same file, on whatever I'd put a link in to the email we sent out to the customer, sending them that actual document. But no, I wouldn't think a lot of linking's done, probably because people don't know how to use it, or -

J Right, because one of the things is that-Some companies have banned attachments of files altogether and they don't use them, they just use file sharing spaces and then just send an email with a hyperlink to the documentation.

T No, we actually do have, in [X], you can send a notification which is- that's- has anyone upstairs showed you the way it works. [shakes head] Well what you do is you send a notification and what happens is, in that, it's an email you get with a link to the [X] database to that particular document. That's what you mean isn't it?

J Yeah, and do people use that?

T Erm, no, not as much as probably we should. Because, when I first worked on [X] I did start using them, but then no one else was using them- I didn't know if that was the way to go.

J Can you think why that might be that no one was using them?

T I mean I find don't get it for a long time. I don't get it for a lot of emails. I don't know if it's quicker for us to do it in lotus notes as an email and just copy the whole thing, than to actually go into the [X] database and just do a notification.

J Ok, that's interesting, good.

T But maybe that could be used a bit more, maybe there is actually some people who don't know that's there, only a few weeks ago I've been showing people that it's actually there.

J So if you haven't been on a course, and no one in the office has shown you how to do things?

T I mean I'm not sure if it's even covered in enough detail on the course, or to make you aware of what it's about. I mean we used to update the program every week, Microsoft project program and I put it in [X] and then I'd notify, because it used to go to about 20 people, because it's quite a big engineering team -and that's the way we used to do that. So people who want to look at it they'd go in, if not they'd delete the notification thing. But there's also an audit trail, which is quite good. So you could actually put a message in when you do your notification of the document, for example you could just say "please invoice this for this price" or people just put "for your information" but there is actually, the way it's set up you can press where you can log it; so if you go into a document in [X] open the audit bit at the bottom you can see exactly what was sent to who, what date, and if there was a message on it. So that's quite good, that side of it.

J so its sounds to me like-

T but we're not using it properly, really, the bottom line is,

J and I'm not unsurprised by that, because I think people tend to usually resent any kind of change, and if they can get away with doing something a certain way-

T Yeah this company is very much like that, we've got better because we've tried to change to make it-but there was a lot of people set in their ways, didn't want to change. But a lot of even the older people have come around and realized well it saves me this time, it saves me doing this, and , but I think that probably is one of / the thing that I haven't really thought about it but just as I was talking to you: that maybe it should be brought up and used more.

J So do you think, I mean I can't think how we can deal with the volume of your email, or what the solution is to that-

T No, I don't know if that, but if it was just coming straight into [X], if there was a way where it automatically comes into [X], I don't know if that can be done, obviously that's down to whoever set up [X] but if your emails were automatically going into [X]- you're not having to do two jobs. And then if you are sending emails yourself, you just send the notification to whoever you're sending it to. I actually think that alone would solve a lot of problems- because we keep getting messages "our memory is too full, our memory is too full" we've gone by our Lotus Notes quota, but it's because we get a lot of attachments obviously, but if were just doing notifications, that would solve a lot of the problems wouldn't it.?

J Well, sometimes it's the simple things that () getting people to do it is another thing.

T But I think if some people start doing it, it will continue this thing, whereas err-.we've had a lot of problems with our servers as well, so you can't always get it into the [X] database when it's down because of our servers so-it's quicker to send an email through lotus notes. So it's- do you want to loose-but you don't do you at the end of the day you have to find a system that is going to save time and be more efficient for everybody.

J Yeah, good. That's really helpful,

T I hope it was,

J What I can't promise is what will come out of it,

T but- well- you've just got to see haven't you,

J From my point of view, looking at the emails in general, and how engineers are using emails, and the information-just trying to get a picture of what it is actually contained in them and how useful it is, how useful the database is, is one thing, that I think we should be able to progress, but as for changes in [X], I guess that's down to [X]. The idea of this was whilst speaking to people like you, we would get an impression to help us when we look at the database, to understand a little bit of background to the project and how your perspective when you're creating the emails and writing them but also we'll feed back to [X],

T Yeah coz [X] will probably be you know, things like that might be-help [X] understand, because I mean a lot of the time people are complaining not saying anything I mean err, coz [X] was there involved in the [X] database, which is our modification database-my one complaint about that was why have we got all these different databases, why can't we just have one database and you just print out different reports depending on-you have all the information in the database, but you can use it different ways, in different areas of the company. I mean I know he's had a headache with trying to changes things for people as well I mean-.you're never going to keep everyone happy.

J Yeah and lots of his stuff is very long term as well- Getting it there and getting it right is a big thing,

T Yeah it's difficult. I'm sure something will come out of this,

J I hope so, well thank you very much for your time,

T No problem

B.3. Project Manager

This is the transcript of an interview of [X] by James Wasiak. The interview was conducted on 2008-05-09 it is 35:05 in length and was transcribed by Craig Loftus on 2008-05-20.

B.3.1. Speaker key

J James Wasiak (Bath)

P [X] – Project Manager

B.3.2. Transcript

P-00:40 Yep, OK

J-00:41 So I just want to start by getting a understanding of how you use email, so possibly start with roughly how much of your day do you spend dealing with it. What kind of things are you using it for.

P-00:56 I'll generate an email where ++ I need to formally tell someone, and to record, with that person, I've either ask them to do something or given them some information to start work. If I want to talk to them about the project, I would use a phone.

J-01:22 Okay

P-01:23 But email is there for a formal communication method, its not there for- To sort of send to your mate, "how did the football score go last night" or anything like that. Its there for formal records of running projects. In addition to that, the way our emails are setup, we have personal email accounts and contract email accounts.

J-01:50 Okay

P-01:52 Any contract specific email that I want recording I would use the [X] database for.

J-01:58 Yep

P-02:00 Any email that isn't really- ++ doesn't signify a milestone, or doesn't need recording in history would go on my personal email, I make that decision, informally. It might be the recipient of the email puts it into the [X] database because they want to record it, but typically, we had an email yesterday, organising a meeting

J-02:29 Yep

P-02:29 That doesn't go into the [X] database. Maybe, If there are any minutes of meetings recorded then they will into the contract database but to organise a meeting you wouldn't necessarily put that on the contract database. Its interesting you say a number of emails?

J-02:49 Yeah ++

P-02:52 I'd say less than 10 per day, I send. It really depends on where you are in the project phase. When I'm in detailed design, interfacing with lots of different suppliers that can double or triple. But at this stage in the contract, we've finished the contract, we've done the, the ships have been accepted and tested and now we're into, basically, dotting the Is crossing the Ts. With things like instruction books + and we're down to maybe 10 emails per day.

J-03:34 Okay +++

P-03:38 Yep

J-03:39 Okay, thats good. Which people would you usually make contact with when you're use an email?

P-03:48 People that aren't within earshot of me [laughs]. If there is somebody two floors down. Like, for instance, our project managers in this company are on the

bottom floor. They are never at their desks, they're in meetings a lot of the time. I'd guess they spend more than 50% of their time in meetings, so I send an email to them, saying either "come and talk to me" or "what are your thoughts on this issue, what shall I do".

J-04:21 You email obviously people outside of the company, you've said.

P-04:25 Certainly, and that would be using the contract database, the [X] database. Any external communications, has a fixed structure, that the project manager has imposed on the database so there is a correspondence identification number so if its the ship builder, which is a customer called [X]. The correspondence structure goes, [X] for [X] (the source), then [X] and then the unique 3 letter number, sorry, a unique number. And then you'll see things, if its to a supplier, it will be R stroke, for instance, [X] and then the unique number and that is all setup within the [X] database structure. On the project you're looking at, it is really well organised. I've seen projects that don't have that filing structure on the correspondence IDs.

J-05:22 So you think it is a well organised project, for that?

P-05:25 Yeah, very well.

J-05:26 Good, okay

P-05:27 But thats not a reflection on me, thats the Project Manager that has set that up!

J-05:32 Sure, sure. ++ Would you ever use other ways of communicating with people than emails, and does that vary depending on which groups of people? Because you said, like, you email project managers because they're never at their desks.

P-05:44 Yeah

J-05:45 And you said you'd phone for more informal design information, possibly?

P-05:48 Yeah

J-05:49 Externally, do you?

P-05:50 No, no, no, no. + That is really- the decision on whether to phone a supplier is really- how well you're working with that person and how urgent the information is that you need. Sometimes emails go unanswered for weeks, if the person is out on business or holiday. I deal with the French a lot and we tend to find that June/July/August is a none working period, for them. [laughs] Usually we give them a chance, 2 or 3 emails over a week or so, and then it is phone calls.

J-06:31 Yep

P-06:34 Yeah doing things by phone, word of mouth, what you said, he said, that doesn't work in engineering. There is no record- the important thing with engineering and project control is to have good paper trail, electronic file, electronic trail of what happened, the chain of events, because at the end of the day when something doesn't work- Who made that decision about doing it this way? You have to be able to follow that.

J-07:01 Do you often go back, have you had cause to look at many emails yet, to follow that trail and to identify things?

P-07:08 Personally, I do not, I- we have a Contracts department who are in discussions with customers, and they investigate any claims and they dig down into the correspondence and they would ask me "where do I start, who said?"- I can usually trawl out a minuted meeting or something like that that was that point. But I dont't- its not my job to + identify, where things went wrong, that is down to our, I don't know the name of the department to be honest, I think it is Contract Services department. They would claim costs against the customer or defend costs against us.

J-08:08 Yeah, sure.

P-08:10 I say without, written correspondence, that just breaks down.

J-08:17 Okay, good. Could you describe for me roughly the role that you played in the project, just to get a narrative of what was your job.

P-08:25 I was the project Lead Engineer, oh gosh- +++ ()

P-08:36 I'm going to draw. I'm going to try and draw an organigram here [laughs], for the contract. There is a Word document for it. Right at the top here we have the project manager, his name is [X]. Underneath him- Do you know what the project is about?

J-08:57 Yeah

P-08:59 Its about electric propulsion, and a quite complicated control system. Basically carrying [X]. Right so, underneath Project Manager is automation and, now it says manager on the organigram so I'm going to write "aut manager", and thats me. Then over here, we have a Power and Propulsion manager, and that has changes a few times of the contract because people have left, but it was [X], I can't spell his name- I'll send you- I'll send [X] the project organisation chart.

J-09:44 If its here in [X] we'll be able to-

P-09:47 Yeah, its right at the start of the project.

J-09:49 I'm sure we'll be able to find it

P-09:51 Underneath me, I have + Underneath [X] he has Commercial Assistants + Maybe, I'll try two. Underneath me theres +, 1, 2, 3 I'd say between 4 and 8 engineers and any one stage in the contract. Similar over here, we have design engineers, each of these parts is given a work break down structure to implement. So I would tell Engineer A, "your responsibility is to do this task" and he ends it, and he has budgets for it and he reports to me. Embedded in that, I do, I also get involved in tasks as well. I'm not sat there as a manager, I'm an engineer. Off the side of all of this (actually no, its not that level, its at my level) I have assistance from Technology Managers. This is off-line sort of support. The Drawing Office + And a few other sort of, key. We have Technology Managers, we have two of those (2 or 3) and I use those as and when needed to consult and then sat between + him, myself and the Power and Propulsion guy is an engineer responsible for harmonisation, I suppose you could call it. To make sure that we don't go our two different ways and give the same requirement (or same function) give two different solutions. So really, I was the automation lead engineer for the project. Sitting off the top here is the development team as well. That is probably about 10 engineers.

J-12:34 Where was your communication- Who were you then speaking to? Anyone with a direct line coming out of that box there, or-

P-12:39 I'd communicate directly, he's- on top of this we've got the shipyard and they've got their suppliers, to get equipment, that we have to communication with. There is the final customers. So this is the shipyard, the people w-ho build the ship. We had two ship owners, [X] and [X]- this is all on a fancy Word thing that you can get on [X]. So my correspondence was with him [X] about money and project planning. So you can put- I'll put project control here and with all these people + technical design. With- I'm making copies to them and copies to them so that everybody has that information- where we are on the technical design. In terms of- If you want to know- Really these number of boxes, there were about 20 different suppliers of equipment on the ship.

J-14:13 Thats really interesting, probably doesn't sound it, but-

P-14:18 Each of these engineers down here might be asking questions as well, direct, but I would be Cc'd on it. Because I'm responsible for keeping coordination and the cost of the project down, which we failed to do. And meeting project timescales. But that is, apart, from the communication paths the organisation is there in [X] fairly early on.

J-14:54 Yeah

P-14:56 And once a month there is a meeting between myself, and Propulsion and the Project Manager

J-15:11 Okay, well the communication paths are very interesting to look at because they'll compared to what is actually in the database, and that is very informative as to how you work

P-15:20 When you see me talk to a supplier on the database, you should see it copied to someone like [X] and if I felt if it had any commercial influence then I would copy it to [X] the Project Manager, as well. Just so he had a- I mean he has so much information to control anyway I don't overload him with "a supplier supplied a bauble (@15:45) and we haven't quoted for it" or something like that. Its- I keep minor things out of his hair, its when things- I can see a thing building up, effecting us that I bring him into the picture.

J-15:58 Cool, okay. I think I covered most of the other bits. I was going to say what kind of task are you using emails for, and what activities is it helping you to achieve?

P-16:13 We did at one point- Within the Lotus Notes configuration there is a way of doing 'actions', recording, putting actions upon people and it prompts the user to say "this person hasn't done the action" or whatever, but I really never got the hang of it. + The control of the project, the planning was all done by [X] with Microsoft Project Planner.

J-16:49 Okay. So, how well do you think [X], actually, kind of, uses email as a communication tool, and how well does it define what it is for?

P-17:02 Quite well. I mean I've only worked the one place in my whole life, which is here- I've been here 21 years. Only another 2 months to go and I'm leaving. But the communication- the use of email communication varies from- its the

Project Manager that makes the difference. Engineers always communicate, I haven't met one engineers that won't put something down on an email and copy to interested, on the fringe, parties. However, the Project Managers, that role can vary and there is a project starting up at the moment where they're not even using the Lotus Notes database for emails. Theres no- See its at the start of the project and I've told the project manager that "you've got to start using this database because-" that project I'm talking about actually has more engineering suppliers than this one. Within [X] we have a dynamic positioning section, an automation section, a power and propulsion section and you need a database with all the information all of what has happened in one place. At the moment its in directories on file servers and its not really formalised, at all. I say the biggest influence on how we use email is dictated by the Project Manager. I think you'll find engineers are quite open with their emails and communication paths are quite clear. Certainly even project reporting within the- Every month there is a project report done and that format is fixed. There is a fixed proforma that you fill in: quality concerns, progress, and lack of progress, issues that have effected you. That get passed up the chain by each engineering working on the project and that is stored on the contract database. This new project that is starting up hasn't had one project report done and it is now 3 months old, so, its not got a good start.

J-19:28 And that is down to the project manager to drive that?

P-19:30 Absolutely! The project manager is the guy that is driving the project. He says "you give us this, you give us this" and the engineers say "we ain't got time" or- but, yeah, the project manager- The project has not been organised at all.

J-19:46 Do you feel there is any kind of driving force in [X] above the level of the Project Managers? Its seems like a company where people are very- quite free to take their own responsibility. Do you feel that?

P-19:59 You certainly own your task, yeah that- there are people that don't own their task. No, I don't think so. As I say this project is going to run and run without communications on the database and no one really will do anything about it.

J-20:27 Would you be able to tell me what project that is, incidentally?

P-20:29 I shouldn't

J-20:30 Thats okay, no problem.

P-20:32 I'm sorry-

J-20:33 No, not at all.

P-20:35 The project was awarded February the 8th, that ought to tell people who it is. I don't want to name names, because that would be burning bridges.

J-20:41 Absolutely. What I will pass back from this interview onto anyone else for improving [X], is- Will be done discreetly, rather than "so and so said, x y and z"

P-20:55 Even the guys- This project the Power and Propulsion on this project was done in [X] in [X] and they tried using the [X] database, unfortunately they had some technology issues and couldn't do it, but I believe now they can use our database, or see our database, and we can see their's, but I've not work on that

project since. The project that I'm talking about not being handled very well is actually being designed in the UK and the guys working on it are 50 yards away from me, its a shame really.

P-21:36 What I haven't shown on there is the field engineers, the commissioning teams that, but, thats on the organigram that you'll see. There is a whole Commissioning department sat, further on down the line.

J-21:49 Yeah, I'll definitely find that to put your communication paths on. So if you, kind of, were put in control of [X], and said, so you could give your thoughts and suggestions and tell them how to do it and what to sort out. What would you-

P-22:05 Thats a very HR type question. [laugh]

J-22:06 Isn't it?! And also from a practical point of view, like from the actual software tools themselves, is there- you know?

P-22:13 The software tools or are you talking about the email tools that we use?

J-22:18 Email tools or, and how they integrate, with the other.

P-22:22 Okay. There isn't a great deal off the top of my head- I mean you've got me on the back foot here. What things can we improve? I'd have to sleep on that to think about it, really. There are probably quite a few things but we do- + really its just been disciplined- the way to improve things. People at the bottom level are, I think Project Managers need a bit more discipline.

J-23:00 Do you feel that the tools are there then, that [X] is a fairly effective database.

P-23:05 Yeah, its brilliant. Its absolutely brilliant. When you put, an email into [X], or you file a document, when you issue it it can't be deleted. Its cast in stone- well actually, the Project Managers can delete them I think.

P-23:23 Theres a drawing filing system called IView + and its a database maintained by our drawing office and that has the facility, once a drawing is approved it becomes unapproved for some reason and actually I found out yesterday, I'm trying to do instruction books at the moment and I wanted to refer to a draw and I looked into the database and it was unapproved. Now, theres no way that drawing at this stage could be unapproved, it couldn't have gone through manufacture without an approval stamp on it. So, the locking mechanism in that database, IView, just doesn't exist. Its a quality issue for the company and I've asked the section leader in the drawing office to find out when it became unapproved, who did it, because I'm a bit of a pickle now. I've got- I'm not really sure what the- all the drawings are electronic, there are no hard piles of paper copies anywhere. I'm not really sure what has been manufactured! So, thats quite concerning me, in terms of- thats, really IView, the filing tool for the drawings is the weakest link in our system. Why the drawing office cannot use [X] and just file the drawing on [X], issue it, frozen, can't touch it?

J-24:59 Okay, well you've been really, really, helpful. I think I've captured most of the, most of the stuff I want to get.

P-25:08 Okay

J-25:10 Trying to think if theres anything else, probably just to come back I guess a bit more to email, in general. You said you've been here 21 years, presumably, 21 years ago no one used email

P-25:24 Fax, Telex,

J-25:28 Its a good tool, its working, do you feel it helps you with your work?

P-25:34 The only problem with email from the project the size of [X] is finding when things were said and it- When we started using [X] database the search facilities didn't really work. Now they do, or I think they do. You do find, people use the Lotus Notes database differently. The Project Manager, if I can't find a document, or something thats not a document- An email from somebody. I know that guy at the top there will find it within 2 minutes. He knows a different way- He uses it in a different way, .when you use the searching for correspondence or whatever, I search for keywords and it find perhaps 30 or 40 emails, eventually you get to the one you want. There is no need to file/structure things to speed that up, sometimes I don't find them and I know if I go to him- I don't know how he does it. He just uses some of the features slightly differently and he gets it.

J-26:54 Great. I did- There was one really obscure thing that you might be able to help me with. Who is [X]? It just a name that has cropped up in the emails, do you know him?

P-27:09 Not directly. What it is- When you see the project organisation, we've got Commissioning over here and then you'll find (aside: Where is it?). There is a load of motors that have been built and switchboards and big heavy bits of electrical power, power [coughs] power stuff. It might be shown here like this- It might be shown here as [X]. He is responsible for motors and generators and it might be shown here, another guy, I forget his name, he about to leave the Company (@28:05.5). They have a company in [X] that builds switchboards. Yeah, its all over this side, and he tells him what he wants of the motor and he tells these people what he wants of the switchboards, its a communication role. I didn't really get involved in this aspect of it I just know there were motors being built, generators being built to the specifications to his design. Whether or not- I think just to complicate things further, he specified the design, [taps on board] he purchased it. So we had the budget for a mini, and they specified a Rolls-Royce. But that, I'm pretty sure you'll see that on the- Right at the start of project theres a organisation chart, a responsibility matrix- and identifying whats what.

J-29:10 Was it generally successful project? Kind of, in terms of things- you know, the story (@29:18.9)?

P-29:18 I don't think its made the budget it should have made. + I suppose it is, I suppose [X] would say it is.

J-29:31 Were there any particular points in time when things were- One of the things I'll do, I'll look at email out of the- taking a sample of emails and marking them up and look over time and we'll see what kinds of information- Was there a lot of design information, was there a lot of admin going on at this point in time and when the emails actually peaked.

P-29:51 The biggest crunch was between November and February last year. February last year, November the year before. We slipped on the software programme, writing the automation software, the ship was being commissioned dockside and we had some pretty significant issues with delivering the software. We had to

employ contractors to write software. That was the most difficult time on the contract. For me, the second most difficult, probably for the project, might have been the first sea trial. Where the propulsion motor, the propulsion system had some major problems and instead of being, like, a 2 or 3 day trial, I think it extended- In fact the customer, [X], got off the ship while [X] fixed the issue. So, that was for me, I think a bad thing because its really an off the shelf product, the propulsion system. It was a shame that it went wrong.

J-31:06 Can you remember when that was?

P-31:09 That would have been march last year, I'd say. And then the bit that I'm interested in is really the gas trial. That was in May, that lasted the whole of may, and for [X] as a company, it was an absolute disaster. Because we came out of that gas trial with two people knowing anything gas trials, that was me and another engineering, our field engineers did not get involved in it at all. And theres another 8 boats to do, I think. Another 6 to do. They did one a few weeks ago, and theres 6 more to do. But they work, they function. I think [X] are going to have a lot of difficulty supporting the boats in service because of resources, we talked about supporting the ship remotely by satellite link and things like that. That costs money, it might be that people have to fly out there to fix faults rather than paying for remote support. We do have a remote support facility set up here, just round the corner from you.

J-32:42 Do you think your kind of communication has all the informational detail that would be needed for service and support there?

P-32:50 Service, again that is another issue. The information is there, its- but theres no point in having information unless you're familiar with what you're doing with- You can't- With these systems you can't- Its not like a- How do I put this? Its not like buying a camcorder and you don't know how it works. You get the manual and you read it from the instructions, from installation. Its not that easy! The systems are vast, complicated, and you have to be familiar with project to be able to support them. You can't rely solely on project documentation. If you had to rely solely on project documentation, the documents would become very labour intensive. There would have to be a lot more detail than is currently in them.

J-33:52 That wrap things up nicely, I think. Thats an interesting kind of comment because thats exactly what our university is looking at or kind of its theme is the how do you convert that knowledge of someone into information thats reusable, or can you?

P-34:08 With the automation systems there is a database in the company called Project Knowledge Support Database (PSKB) and I was looking, just when [X] phoned me to remind me to come down today I was actually in that database trying to find a data-sheet for a particular component in the automation system. The concept is there, maybe the implementation isn't right because you can never find anything in it, but- I think the company is quite well organised in terms of recording knowledge and the use of its emails. The use of its emails is very specific to which Project Managers on.

J-34:57 Okay!

B.4. Warranty Manager

This is the transcript of an interview of [X] by James Wasiak. The interview was conducted on 2008-05-09 it is 35:14 in length and was transcribed by Craig Loftus on 2008-05-25.

B.4.1. Speaker key

J James Wasiak (Bath)

N [X] – Warranty Manager (PowerCon)

B.4.2. Transcript

J-00:28 First things that I have to try and develop and understanding of how you use email. Where it fits into your work. So just roughly, how much of your day you spend dealing with it and what kind of things you use it for.

N-00:40 Right. Before I answer that one. Are you looking at this specifically in relation to this one project? The [X] project, or are you talking about generally? The reason I ask is that I am sort of semi-detached from the [X] project. Its not my day job. So where are you coming from?

J-01:00 I'm happy to deal with either but really the [X]. If you can just see it as, you have one job in [X], if you like, and one job somewhere else, kind of two different roles that you play.

N-01:12 Well, my actual role, I'm supposed to be working for Electrical machines which is based over t'other side of the river, building 140. And I look after warrantee issues. I was asked to help out with [X] because they needed some assistance. So when I'm saying I'm semi-detatched from it.

J-01:34 I'm with you.

N-01:37 If I was based over here I would probably- I may not need to use emails quite as much. Do you understand where I'm coming from? Its effectively like being out on a site. Its away from here.

J-01:51 Okay, I'm with you. So you actually work away from- you're not based in this building.

N-01:54 I'm not based in this building. I'm based about a mile away.

J-01:57 Right, okay.

N-01:58 So, having said that. How much time do I spend on emails everyday. Well emails are just a tool. It might take half an hour to write an email and send it, but there is all the rest of the work involved in it. So, emails, per say, probably about an hour. The emails are just a communications device.

J-02:21 Absolutely. So, you feel that is fairly effectively spent time?

N-02:28 Yeah. Emails are just a communications device.

J-02:32 Okay. And what kind of activities are you doing? Are you mainly dealing with emails that have been sent to you and you need to respond to or are you emailing afresh and following on from a conversation.

N-02:45 Both.

[Tea lady interrupts]

N-02:56 Right. My main role on the project is, I come in at the end of the job to try to recover as much money, sort out problems etc. So, I'm not involved or I haven't been involved in the day-to-day running of the job. Which means that when I come in, I've got this great big database which, I've then got to try and find out what has happened over the previous couple of years. Very, very easy if you've got paper copies of things because you flick through files- Absolutely impossible with [X] because something that would take a second with a paper copy takes a minute with the [X] database because you've got to open it up, try and find where you can read it, establish whether it is something thats of any use, you then need to print it off because if I close it again I've lost it. No, I need a correspondance file where I can actually establish the audit trail (is I think is the way you would describe it). I've got to have the arguments each way. So, for me it was useful having the [X] database because the information was there- It was a right nightmare trying to find anything in it because it took so long trying to find the information.

J-04:22 Right. ()

N-04:24 But at least it is better in a way because, at least the correspondance is there. As opposed to when you take it a stage further when I'm trying to put together claims etc you find that people have then got private emails that haven't gone anywhere. So private emails I can't get at.

J-04:47 Yep. So you don't know whats been-

N-04:49 Unless I'm lucky nough to stumble across something, basically the disciplines of 30 or 40 years ago when everything was in hard copies and there had to be a master copy and it then went through one person because that was the only way it could be done years ago. People seem to froget the need for some of those disciplines. Its got to be discoverable and I'm probably as much to blame as everyone else. You get so used to just firing off an email and its- perhaps its not always filed away in the most logical place.

J-05:37 Yeah. So you- is your interactions with email are mainly looking at the database and reading emails that have already been sent.

N-05:45 Thats one aspect of it. The- what I've been involved with more recently with [X] is because there were problems that needed sorting out, I've persuaded the project manager that what he needs me there- What he needs is to have me there at an earlier stage, so stop the issues becoming problems.

J-06:07 Yep.

N-06:09 Right so, what we need to do, we need to ensure that the customer is kept fully informed as to what hes asking us to do, because we're spread all over the place, the customer is spread all over the place. The one thing that customers don't like is to think everything is going very very well and then to suddenly find at the end of the day- "oh could you pay us 5 times the amount that you were planning to pay us?". If hes got a problem he needs to know that hes got a problem and hes going to have to payout more then he needs to know that he is going to payout more and if he sees costs are rising it may well be that he can

do things in a different way to avoid those costs. You know, you can go around incurring costs on behalf of the customer and then expect the customer to pay it.

J-06:56 No, absolutely.

N-06:57 So. Theres different ways emails are used, as I said, researching back through other peoples emails is one element of it. Ensuring that I'm keeping the customers, whether they're internal or external customers, informed- notifications, that sort of thing, is another aspect. A thrid aspect is recieveing information from site, things like, because they're operating on the other side of the world instead of just photocopying and sending things through, by post, which actually might well be the easier way of doing it, they scan things in, daily logs and fire them across as email attachments. Problem with those is, of course is they're big emails, which then bring us on to the other problem that we have- That the IT department keep on saying, detatch emails, well if you did that- detatch attachments, thats all very well but if you detach them, you don't what it is you've recieved and when. I'm not interested in what we finally have, I'm interested in where you get to where we're going, because thats where I make the money.

J-08:14 Okay.

N-08:16 So. For me it is absolutely vital that if an email comes in with attachments those attachments stay with that email.

J-08:22 Are the type of attachments you look at, documents that are likely to change and be updated later on. Because that would obviously-

N-08:28 Could be! Particularly for example, drawings, for me, I've got no interest what so ever in what a final drawing is. I'm interested in the changes. So simply going to a computer system and saying "there you go, thats it"- "yeah, okay, so what. So, how did he get to that?". Thats where I come from but then again I'm probably what you would call a Claims Merchant. My training is a Quantity Survey. Actually had an interesting expression a couple of weeks back, which I've never heard of before, where they referred to forensic quantity surveyors, which is basically what we do. So, thats how I used emails.

J-09:15 So, because obviously we have tools where you can a file which is kept on a server somewhere, and updated, like a drawing and the engineer can look at the most up-to-date drawing because thats all he cares about.

N-09:24 Thats what the engineers needs, he needs to-

J-09:26 You need to look at every different point, or at different points in time but not just what it was on a certain date also what correspondance it relates to.

N-09:35 Absolutely. I'm looking at the way time gets expended, you know, if the customer does something which causes us to incurred additional costs, I can get that money back off of the customer as long as I know he has done something to help make us incur additional costs. Having a customer turn round to use and say, "You should have had this work done in January but it took you until November to do it. You were absolutely useless." Is no good. I'm going to be able to say "Well we would have had it done in January if it wasn't for that fact that you didn't give us the information until February. And when you gave us the information in February you then change it in March, etc. etc.".

J-10:27 Good. Okay. Thats quite insightful, especially coming from an engineering background. Obviously your role in the project, although its not engineering its very important.

N-10:37 I struggle to speak Engineerese ¡sic¿ I can never understand what engineers say.

J-10:43 Well, I'm from a Mechanical Engineering background so looking at some of the- this is more a control system project and systems engineering, its all a bit baffling for me.

N-10:54 Yes. I know what you mean.

J-10:56 Yeah. I'm running through my questions that I have to say- What role did you have in the project? I think we've covered that one fairly well. Who are you- who did you communicate- What- Can I have what date you came into the project? Do you know, when abouts it was, just roughly?

N-11:13 [sighes heavily] About 2 years ago. Honestly, I don't know, I'd need to look the information up. Couple of years ago. But like I said, I came in late when there were already problems on the project. One of my difficulties is I get the impression every job we do is bad because those are the jobs that I see [laughs].

J-11:44 So who are your- the people you are then talking to as part of your role, who do you communicate with?

N-11:50 On this particular project the project manager is [X], okay. Now, [X] is the focal point for everything, as far as I am concerned. On site we've got [X]. Financially we've got [X]. We also have the [X] Office and thats generally looked after by [X] [spells-out] (I think it is) and the surname is [X] [spells out names]. Okay. Thats for the [X] office, effectively its the sort of thing that you would have normally had people sat on adjacent desks not spread over the world! So that is the, if you like, the main players within PowerCon. Additionally to that we've got [X] who originally I wasn't involved with very much because she was looking after one aspect of it, which was an aspect which I didn't deal with. But the more I've got involved in it, the more I'm making sure that I'm keeping in contact with her, and she keeps in contact with me. Just keeping each other informed. And then I deal with various people working for the- our customer which is BTP, and generally speaking they are either called [X] or [X] or- [laughs]. So, I don't have a great deal of contact with the customer, unless [X] asks me to send formal notification. I tend to write the more formal type letters stroke emails.

J-14:16 Okay. Thats good. So your role with the [X] is really formal stuff, that you've been requested to do by [X], often.

N-14:25 Yeah. If you like, I tend to get used as the bad cop.

J-14:30 Yep. Thats fine. You keep [X] in the loop as to what is going on with things.

N-14:37 [X] if it is things that I believe [X] needs to know about. And as I'm discovering more of [X]'s role, I'm discovering that there is more she needs to know than I thought she needed to know and think she is discovering that I need to know more than she thought I needed to know. We had never been briefed on what each others roles were.

J-15:02 You obviously speak to [X], is he your- is he driving the direction you're going in?

N-15:10 Yes.

J-15:17 And, kind of, what would a typical email between the two of you be- can you think what might he be asking you to do or you asking from him?

N-15:25 Generally speaking I don't send many emails to [X] other than if I'm sending a formal type email I will send him a draft of what it is that I am going to send. Other than that I might confirm a telephone conversation back to him, "this is what you told me to do". So generally speaking the emails that I send out, tend to be emails to the customer on behalf of [X]. Emails that I recieved tend to be coming from with the PowerCon organisation, but on occasion from the customer as well.

J-16:16 And what kind of things are they-

N-16:20 Information coming in from- you know, as I said, the logs, whats happening on site, that sort of thing. Keeping me informed as to whats going on. Then what we get back from the customer, on occasions, a response is to the emails that I send out, they don't respond as well as they should do in my view. You know, we try to keep them informed but then they don't reply. Now, there is a danger with emails, and I've seen it on a number of projects, when you think you've done what you need to do just by sending out an email. Thats not communicating, that is- Whats communicating is when you get in touch with them by other means, phone them, speak to them or whatever, and you then confirm the discussions by email. Thats using emails properly. You may then get a line of correspondance that is generated from that, but simply firing an email off out of the blue, tends not to get a very good response.

J-17:26 Okay. Can you think of any other people you speak to, that you're involved with in any specific relationships?

N-17:37 On this particular project? Various people I speak to, [X] for example. Speaking to him today. [X] on site. [spells out] [X]. Who else do I speak to?- Deal with in the organisation- On this particular project, that is basically it. As I said, it is primarily [X].

J-18:44 And are these people, are you talking to them by email or by telephone or-

N-18:51 Yes.

J-18:53 Both?

N-18:54 Yeah. One should never use email exclusively. For example, [X]. I was just speaking to him on the phone, there, just before I came across to see you. Emails do tend to get used more often on this projec than on a project that would be based in this country simply because of the time differences. So effectively, one particular type of email is effectively a telephone conversation by email. So in terms- again, thats something thats perhaps worth mentioning. That you've got your formal emails that you send outside the organisation, but what you then have with in the organisation are a conversation. So you get different types of email.

J-19:48 Okay. We're doing well. I know it might not seem like it.

N-19:53 I'm just trying to give as much information as you need.

J-19:57 Its really good. Kind of speaking to- I've spoken to a few different people and where they sit in the project, different viewpoints have different requirements of email, about how well it (@20:03.0)

N-20:04 Of course they do. Of course- and that is always the problems- how do you consider everybodies needs? So, you know, one of the biggest bug-bears we've got is that the [X] database is absolutely brilliant for small jobs but once you get to the likes of your T45s and your [X]s and whatever it becomes unmanagable.

J-20:44 Do you think most people share that view.

N-20:48 Yeah. I'm sure they do.

J-20:55 And is there- skip on to [X] then. People have lots of interesting things to say about [X].

N-21:07 Good or bad?

J-21:08 Both. Real mix. Did you ever recieve any kind of training on how to use it, or an introduction to it?

N-21:17 No! Training?!

J-21:19 And do you feel that- do other people generally?

N-21:25 What on [X]? I have no idea what other people have had as training. So, I'm sure there is a lot more that [X] can do but I ain't got a foggiest idea what it can do.

J-21:37 And would you- generally when it comes to dealing with computers, electronic communicational software tools, how comfortable do you feel with them? Or would you just rather be with a paper and pen and a filing cabinet?

N-21:52 I use computers for what I need them for. You know, everything that I work on, they can probably do a darn sight more than what I use them for, you know, Excel for its spreadsheets for example. Very powerful tool, but I use it almost as a database at time. Most people do. You use the simple things, and most of the time that is all you need.

J-22:23 And would you like to use the tools differently if you knew more about them?

N-22:28 Not really, no!

J-22:29 You're quite happy with how things-

N-22:32 Once you start trying to use the more complicated elements of it then, that may say you start, don't use some of the simple elements from other tools. I think, keep things as simple as possible and you're far better off, its when you start to try and complicated things that things go wrong. Classic being SAP, now that is a disaster!

J-23:00 SAP, is this one of your?

N-23:05 This is the accounting system that they use here. Absolutely flaming useless. From my position, from the accounting position it is probably a brilliant tool, but it doesn't do what I need it for. We've actually come to the conclusion that we need to now go back to keeping files. The sort of things you would have had back in say the 1970s and 1980s and just use SAP to record the answers, can't

use SAP to do anything decent with it. Its far too complicated. The important things as far as I'm concerned is keep it as simple as you can. And if you can simplify it even further than that, then do so. Again harking back to [X], one of my whinges on [X] is that you've got this enormous great big header that fills up your screen. I'm not interested in the header! I would rather- That header, if that was down the bottom so you could actually read what the content was, great. You could then go to that other information further down, that might be useful. But the stuff you don't need is the stuff you see, when you open it up. Which is why I say you've got to print the stuff off to try and find out what it is all about.

J-24:30 What other problems do you think there are with [X] or-

N-24:37 The fact that none of us has been- (@24:40) I've not been trained so I don't know how to use it properly. Simple as that. But would it have been useful for me to have been trained in it and then not used it for another 2 years. By the time I'd have got round to use it I would have forgotten what it was all about. So, [X] is a good tool, but it is simply a filer- A filing tool. It creates the need for far too much paper in my opinion.

J-25:36 Could you explain why?

N-25:38 Exactly for what I said to you previously to be able to use it you've got to print the stuff off.

J-25:42 You've got to print the stuff off.

N-25:43 Yep. I can't- I've got this list of things on [X], with little one liners which don't mean a great deal to me, so I open it, "oh thats useful", close it, now where is it? If I find something useful I've got to print it off. If I find something that might be useful, I've got to print it off. If I find something thats got a line in the middle of it that is useful to me, I've got to print it off so I can highlight it. Because I can't go highlighting it in [X], because other people are using it. I can't go mucking about with it for me to be able to use. But then I again, as said, I am semi-detatched from the project. So I'm looking at in a completely different- My needs are completely different from most other people.

J-26:38 Which is always going to be an integrally difficult problem. About how you create-

N-26:46 So theres no point in me whinging and moaning about something which isn't set up for the way I need to use it knowing full well that for most other people probably is good.

J-26:55 But if it could be such that you had, kind of, the core workings of [X], if you like, are hidden, but the view that you get of it was different to the view of someone else had of the same information.

N-27:08 Theres always a danger with that as well. That if different people get different views then people will be assuming that you're getting the view that they're getting and you're assuming that other people are seeing what you're seeing. Its far better to just have one- Keep it as simple as possible, thats the thing that I would say all the time. As soon as you start to complicate it, you're in trouble.

J-27:40 Would you have any suggestions then for how to make-

N-27:47 The biggest improvement I would make is get rid of the banner at the top or at least relocate it, because the information that I want is the text. In other words, if you get it to look exactly the same as Lotus Notes, when you're sending emails out through Lotus Notes. Because Lotus Notes has got exactly what you need on it, its got a From, To and Date, Title. Thats all you need. [X] has got, masses of stuff. I don't know if- You haven't got a print out of anything on [X]? But, the banner on [X] goes down to about there! [gestures] Now all of thats rubbish, and not only that, its got a number of different dates on there- well, what date was it sent? Don't know, ain't got the foggiest idea when it was sent. In fact sometimes it says draft on it, but it has already been sent.

J-28:45 Yeah, I have looked in [X], to take stuff out and its- confusing.

N-28:49 You can't follow it, it is difficult to follow. So, as I said, get it to look like Lotus Notes because I like Lotus Notes.

J-28:59 Right. So, Lotus Notes is a good-

N-29:06 For my purposes its useful because it is simple. It is what it is. But you also need the database capabilities, the filing capabilities of [X]. So it needs to take the best from both bits, in my view.

J-29:38 Yeah. Thats what I'm here for, is your view. Yeah, absolutely. So its almost- looks like Lotus Notes, have that kind of interface but to have filing-

N-29:54 The search capabilities that [X] should have

J-29:56 And how do you find searching in [X], is it a-

N-29:59 What I do is- Generally speaking I go to global correspondance, sort by date, and work my way through. You need- To find something you need to know that its there and where it is [laughs].

J-30:13 Yeah, so you just go to global correspondance, put them in date order and start your-

N-30:19 Yeah, yeah. I'm sure there must be a better way of doing it.

J-30:22 Do you ever use word searches at all?

N-30:24 I've tried it, it doesn't work very well. Certainly for what I use it for, because I'm looking for the unusal. Now if I just do a- If I do a search for a particular word that may well pick up 70% of what I'm looking for.

J-30:51 Yeah. Are the type of emails that end up being useful for you, is there anything kind of typical about them. Do they have anything in common or can it really be anything for any job depending on what it is you're chasing after.

N-31:08 Right. Looking at it from the role of building up a claim then it really is just a case of trying to establish what went on and when. So it doesn't matter what is in there I just need to be able to get the story together and then use that to substantiate whatever it is that I want to say to the person that I'm speaking to. However, the problem that I've got is when the people don't go writing the emails that are needed. So, it needs to be well managed in my view.

J-31:43 And whose responsible for the management of that?

N-31:46 [X] as always, because he is the project manager. And again, I've said this to [X] plenty of times he needs someone like me on it full time. (@31:58) My role as quantity surveyor, I look at the financial aspects and get the notifications in place as and when they're needed. I am generally able to draft out the emails- the correspondance, to instigate the discusssions that are needed with the customer for example. But its- What I'm always looking for is notification- timely notification.

J-32:42 Timely notification of things. Okay.

N-32:47 Because those are generally the keys.

J-32:52 Speaking of timely, how are we doing?

N-32:53 You've got another 10 minutes.

J-32:54 Okay. That should be fine. I don't think that theres any more I need to ask actually. I don't really need to ask you about how you use emails for engineering because you don't design very much, I hope.

N-33:05 One would hope I don't design anything at all. But the way I use emails for engineering is, I go and talk to engineers.

J-33:10 You don't. So, yeah, if we just come back to you using emails, not searching through [X] but just as a communication tool. The kind of things you're using it for when you speak to engineers, is it, you prefer to do it face to face or over the phone?

N-33:32 Yes and No. In so far as, if I speak to them, I believe it is essential to confirm it in writing. Because unless it is written down, it hasn't occurred. Its like, when it comes to things like minutes. It isn't what is said in the meeting it is what record that has been said in the meeting. So very often it can be better to write the minutes before you go into the meeting. And then have the meeting to just confirm what it is that you've already written.

J-34:06 Yeah. Thats interesting. I'm trying to think if theres anything. I think I've- I feel like I've really covered kind of what I wanted to-

N-34:23 Well if you need any more from me, call me again!

J-34:26 That would be great if because I'll- What I'll do is I'll go away and think about it and talk to Craig about-

N-34:31 I ought to have some cards on me but unfortunately I haven't brought any with me.

J-34:35 Well, [X] will have your contact details. We're here the beginning of next week-

N-34:38 Okay. Well, my telephone number- Extension number is [X].

J-34:41 Yep.

N-34:43 My email address is [X]. Or if you're here using the internal email just stick it in [X] or something like that and it will find me.

J-35:00 And it does it? Okay. Brilliant. Okay, well if I come up with any questions or things I think I've missed then I'll get in touch.

N-35:04 Okay. Cheers.

Wrapping up interview

B.5. Service Engineer

This is the transcript of an interview of [X] by James Wasiak. The interview was conducted on 2008-05-12 it is 76:00 in length and was transcribed by James Wasiak on 2008-05-30.

B.5.1. Speaker key

J James Wasiak (Bath)

M [X] – Service Engineer

B.5.2. Transcript

J-01:55 Could you just start by giving me an outline of how much time a day you spend a day working with email, personally, not as in retrieving from the [X] database but just, your use of email helping in your role.

M-02:11 Hmm, that's an interesting one, depends, Friday was fairly heavy!! Erm...in terms of actually writing emails or reading them? ()

J-02:25 I mean in the sense of ()

M-02:27 All right, I mean I'll get an email come in, it takes you five minutes to read it, but then you go off and two hours doing something else, and then you spend another five minutes writing an email response back to that person so, you're using email - 10 minutes, job associated with that, two hours and ten minutes,

J-02:43 And that's fairly typical of your kind of work?

M-02:46 It is fairly typical, because what's happening is, especially in the service organization, is you'll get an email in with, "I've got a problem" with some brief outlines, now you may, depends ..and this is how we use email, it maybe that you call the ship, but invariably and certainly with my background is I tend to do with [X] is put it down in writing because it takes the ambiguity out of it so if you're like I see the email bit as important because it takes away the ambiguity because you can put in specific questions and say, and answers to each of those specific questions, so it's important so it varies according to the how to use it, erm... typically you'll get an email in there and now you'll have to go off and sort something out, come up with some questions, some answers from one of the technical guys, put that together and send it out. Because often we're the buffer with the service organization I don't what the guys upstairs in Engineering dealing with the customer direct, so I'm the conduit. So here's a problem, right, go up and see an engineer, get them to give me some questions to ask, put that into an email...in hopefully an unambiguous format, and then wait for the reply to come in, and then act on that.

J-04:19 Do you use things other than email to communicate with clients, or is that really the main thing...

M-04:25 I mean but the, obviously you will talk to someone on the phone, but often you will get, depends who is at the other end and to what level they are trained.

That could be quite critical, once you get to know your customer, you know that, if you ask somebody, this particular person a specific question, you know, because you know him, you know he's got good-that the way he is, that he will give you the answer. Whereas if you don't know the person you might ask them the question and they'll give you an answer that they think you want, rather than the reality check. And so that's why (certainly from my previous years in service organizations) there's () especially if you use the written format, especially with non people whose, for whom English is not their main language.

J-05:27 Yep

M-05:27 So their can be a lot of "is the red light on" "yes" well that actually means, "yes, I've just understood what your question is but the answer is no, it's not on" [laughs] so if you word it and you do it in writing you say, "tell me what colour is light number five?", and they come back and they'll tell you it's red or green+ I mean that's a simplistic question to answer but sometimes if you do that in verbally it doesn't come out. So our to methods of communication with the customer, (fax doesn't really come into it, forget fax) we're dealing a lot of the time with some boat floating about in the middle of the ocean so it's usually telephone or email communication on that. But going back to your question of how long, I suppose reading and writing emails 1-2hrs a day, again it depends sometimes an email is just a simple question and answer, sometimes which may or may not be a good thing, emails have a lot of technical stuff buried into it and there's always that fine line, when do I take that information outside and put it into a word document, pdf it, attach it to the email and send it, as opposed to having a very long email. And I think a lot ofemails can be, I'm guilty as everybody else () trying to make them smaller, obviously emails should only be a few lines and stick everything else in attachments; [X] has a lot of two of three page long emails which may or may not be +

J-07:35 I've seen a few

M-07:38 That's always, you know the, we're digressing away from your questions a little bit, or whether this is useful information?

J-07:42 Yeah, no we're leading just fine

M-07:44 Erm, because it's, to me its'-I'm looking for information, if I can find it in a document, "oh yes, I told you how to do this, it's in that document" which is again correctly...has some sort of meaningful title to it, that you can look for a specific document, and that document is referenced in that email and has been attached to it, but sits in a master place where we can go and find these things. If you bury all that technical information in an email it becomes far more difficult to retrieve it because you're looking for keywords, causeyour only search facility then is in keywords, and all those keywords are embedded in that, whereas if you're looking for a document written in the 15th July 2007 you can go and find that document, you know roughly what it's called.

J-08:40 And do you find then, using attachments have version control issues with documents being updated, is it problematic, to say that when you attach something, send it and it's there-it exists as a copy of what was the truth on that date and that when you look back later on..

M-09:03 If you've got+ one of things I've found within [X] is that it's trying to find where the master copy of the latest version is and with document control that's easy, there is a file up there, there are procedures and everything else, with emails....nothing. If you've got-;I have to deal with the warranty issues on [X] so actually what I've got now is a master file which sits in the [X] database and that's , you know you can book it out, update it, book it back in and save it, and I control that document. It's done within [X], I mean where I came from before we wouldn't have done within [X], you know it would have been on the server, in a folder, there's the master document, there's the one we just keep updating. So there's a-, [X] uses a database way, what I did before was just a folder on a server under a sub directory. But there are times when (), If you've got stuff buried in an email it's not controlled, whereas if it's a document outside you're usually talking about, I mean we've got templates here which you've probably come across, which are easy to chuck up the revision on it, on the date, you save it, stick it in an archive folder and start a new one. And that works, and certainly with the warranty issues that's how I approach it, or I use the [X] database; that's controlled, we save the old one, and I've got an archive folder where all the previous versions sent out are stored and the current version is that one that's there, that's the live version.

J-11:05 Ok, we touched on it a bit already, but can you describe in your own words what your role is – your job if you like, within the project, the [X]; I don't know if you're working on other projects-

M-11:17 I'm working on other things, but specific to the [X], I'm working on the warranty issues, so we've handed the vessel over to the customer and its got a two year warranty, so during that two year period – I'm looking after the warranty related issues within the service organization and the main business is looking after anything to do with the original contract that's not warranty issue related. And then at the end of the two year warranty service will take over everything, because by that time there shouldn't be anything outstanding from the original contract. So you've got, at the moment, it's different: a lot of the way that outside of [X] (just as a background) what normally happens is Main Business build it, install it commission it, everything, look after it during the warranty period, and at the end of the warranty period hand over to service and say "here is a vessel/rig, whatever is happens to be, here's all the documentation, here's.." then there's a formal handover – service then takes it on from the end of the warranty period to the end of life. With [X] there's a conscious decision to, at the point it's handed over to the customer start a warranty period – service is now involved looking after all the warranty, and service, contracts, anything else like that through to end of life. So you know –well sorry – warranty period then carried on from there. So its' a slight change to the way the company has approached for the [X], which is working well. So I am managing – if there's a warranty issue that gets raised by the ship, comes back from the ship, to the ship yard, back to me, here is a warranty issue it's up to me to manage giving the appropriate resource whether it's field service, internal engineering, whoever. To solve that problem, get it fixed, tick it off, close it down, done.

J-13:37 So you're obviously doing a lot of co-ordination between the different parties involved,

M-13:43 Yes, in those terms, I've got to deal with – it could be field engineers to go out and look at something, it could be because they've identified software problems, so it might be people here in the engineering group, service engineers hers, it might be (because the contract covers propulsion as well) it could be with [X] because they do the drives, the guys in [X] because they built the motors and generators, it could be guys upstairs who are – do the automation systems. So-

J-14:22 You can be talking for a kind of what would we expect to see in our group of emails – you could be talking to anyone-

M-14:29 Yes – I mean obviously-

J-14:30 -who has been involved in the project,

M-14:32 Yes, yes but the, what you're trying to do is to-work out that key person, and there maybe somebody on the CC list to do it. An obviously to get your etiquette right with emails, then, he just knows what's going on, without having any actions on there.

J-14:52 So what's it like then when you, the problem crops up – I'm thinking more from the client / customer point of view – an issue occurs and you then need to look back at documentation or correspondence in [X], what kind of occasions would cause you to say "we need to look into that"?

M-15:13 At the moment, it would be – if they're claiming something is-because I don't have any previous knowledge, I guess if the customer says "this doesn't work and it should do" then what I will be looking for is being able to go back and find out, well was that agreed with the customer, did he agree to do it this way or that way? Did he sign off on something? I don't know, so that's the sort of thing that independently you'd want to use [X] for. Would be to – "the customer says it should perform this way and it isn't" is to find out who agreed – should it be performing in this manner or that manner, and trying to find out where that's - where is that information. And invariably I just go "haven't got an idea" and I just go down and see the project director and say "what did you agree" [he says] "well I don't know, you better go and talk to maybe so and so " - and you do it by process of elimination, by running round the building and eventually you find out – get your answer. Because I don't find it intuitive in [X].

J-16:31 So what would happen if those – if everyone who worked on the project – the first vessel is now ready?

M-16:38 First vessel's in operation second one's about to be ready...

J-16:41 So, [imagine] everyone who's worked on the first vessel leaves the company – retires, goes on holiday; a service issue crops up – would you have a hope of being able to-

M-16:53 I have found information within [X] by-we had an issue with some () screws, and it's like doing a Google search, you try that and you get hit with a whole load of emails and you – some of them become "ooh that looks like it might be relevant" because you know who to, you're looking for the people and the subject matter, because you only see the first person that's on the email, the way that Lotus notes works, so if you search for Fred Blogs and it was sent to Joe Smith, you don't fin Fred Blogs because Joe Smith's the only name that shows up on the name column. People don't use subject matters very well. And

an interesting thing with age, with the [X] is that, KA have specified that all emails pertaining to the tanker should start with a key bit of information, so it always starts with: the ship yard code, the hull number, the name of the vessel, so it's like you include that bit in there, and from there on you put something in there that's kind of relevant – so with the warranty things I put that first bit, plus the warranty number which start EME and then a three digit number and then some relevant, you know, verbage. So the first bit, although it make the subject matter a bit longer, the first bit now means you can search. If I want to look for anything to do with warranty number 125 I can put in EME 125 as a search and it will pick up everything. Now as long as everybody sticks to that-convention, you've got it, now since KA are the ones who've said "this shall be it" or whatever it happens to be on pain of death or whatever it happens to be then it's there. Now that actually works really well, in terms of how you can go and search. But if somebody doesn't stick to that and they just write "encoder failure" well there could be thousands of things related to encoder failure, some of which are absolutely relevant to what you're looking for and some of them are just, you know, something that's going back – "what happens if the encoder fails". Hypothetically – because the subject matter is not very good. So from that point of view it's not very good.

J-19:39 Incidentally is it confusing then, because obviously KA are just one of the clients you'll be dealing with, do other companies have their own specified header information

M-19:50 I haven't come across – I mean some people you can see it, they obviously have their own internal convention and you can see it that it comes in with something and there's a – what can you call it – "a footer" I suppose it's a footer, at the end of the subject matter which gives it – may state the vessel and the date on it or some code which is in their filing system, and I know that [X] I think can do it, it can tag information on there. So whilst they haven't insisted that this is done you can see from how it comes in, it's obvious when you look at a subject matter, that's giving them some -on theirs-when we send it back out if we've used a reply then you've got that in the trail, so you've obviously got the key, but that doesn't give our internal reference. And we're not logging, I suppose from our point of view you don't log a problem, you don't give it an incident, you know, where I came from we were doing things (I mean we're digressing slightly) but I mean, when we had a database which we used to log all problems coming in from the customer. So when it came in and it was not just a simple yes no, do this and closed this is something that is going to go on, you would log it as an incident, it would get given an incident number, now you can quote that number, you've got a reference point back into that database, you know how did you know, so you spilled up everything below that database, so -[X] can tag things if you sent an email, but we don't have a database for my one where we give a number to. We have a database that service uses, we can open it up but doesn't give a reference number to it, but it could be changed. But yeah, no – there are other customers with systems, but KA are the only one at the moment who insisted that everyone should do that, so they can search and check.

J-22:26 Ok, step back a second then, we've talked about the things you're looking for

and searching for in [X], you've certainly looked to see at what I would consider contractual kinds of stuff "what someone agreed upon" is there anything else, any other kind of, I'm trying to think from your point of view maybe not-or would engineers want to use it-

M-22:51 Well yes there is, in terms of what the engineers-if they're looking for software there's a separate thing outside of [X] in terms of the software versions, things like that, they are within software control. So the guys within service will want to know: "ok I know the vessel, but I want to find the latest or the history" they know exactly where to go to, it's not in [X] it's in the software control and they know where to go and look to pick at that information up. Drawings, we know where to look, they can go to their pile of drawings and look through them, old issues, current issues, retrieve that data. It's I mean I don't know I haven't used [X] a lot, I haven't had to use [X] a lot from that point of view, I possibly don't-again it's difficult-it's not a tool, because [X] is really a project related thing, it's not suited to the service operation, and we've got to sort of, the forerunner of [X] is what service uses and it's much cut down – called [X] light, it's not quite, but it's a cut down version of that. It's not as good as; it's really a correspondence database. And people know where to look in it, certain information in there – I mean again it's not unintuitive, I mean I don't look into [X] that often from a service point of view. I mean it's only if you want to go and find something, some specific bit of information, and invariably it's actually quicker to go and find somebody. But I mean If you took your scenario where they've all decided to quit or they've all gone on holiday, then yes you can search, but which bit it's in is not always intuitive unless you know how that person put the [X] database together and how they, I mean I've worked with people and I think, why do you want to go and put it in that section – I can't see the logic; but they see the logic in seeing the information filled in this particular branch of the [X] database, to me it didn't necessarily make as much logic, you know, maybe there's just too many areas where you can put things. You know for it to work you've got to set up an awful lot of rules and let people adhere to them. And I've always found that with that sort of database. If you set things up, and you come up with a set of conventions and you get everybody to adhere to it, it makes searching a lot easier. I do find searching [X] quite difficult. You approach it in the same way as you would searching on the internet for something using Google. Just sort of, you put some keyword in there, when you get to many hits you refine your key words until you start honing down and getting into the swing of things.

J-26:22 What you said kind of ties with the feel from other people I've spoken to about this, the structure of [X], how that works and the difficulties with searching it and then I don't know whether it's the lack of consistent practice across the company.

M-26:39 I haven't used it enough, but I, as a comment that I think would apply to [X] is does - are there things within [X] is that consistent practice or is having a working structure, what we used to call you know under you ISO thing you'd have a process and procedure when you have work which is such / specific and you need almost a very specific working structure that says when you do this, thou shall do that, that and that. From this convention, then if everybody sticks to that then you stand a much better chance of finding the information you want if you come in as an outsider, looking in. And I think at the moment there's too

many, Joe does it that way, Fred does it that way, so and so does it a different way, and within the constraints of the database, but they all have different ways of putting information in that. So it makes it more difficult to look in from the outside and find something.

J-27:49 Erm, have you – if you're involved in servicing are you dealing with any projects that are considerably older, that are further into their life.

M-28:00 Oh yeah

J-28:02 I know – we've moved away from emails slightly, but I feel it's the in service – the information that you're dealing with which is more relevant for us.

M-28:15 I mean service has, from what I gather, come together from various different groups over the years, and it is now this of marine and offshore service. So we've got old vessels with very old equipment on it, and up to vessels which have just been built and commissioned, or other ones which have been built, commissioned, gone through their warranty period gone to service, I mean I've just taken one over that's been, that was an old vessel- I mean some of these are old vessels which are then get bought up by somebody else, get modified, become a different vessel completely, have a load of different equipment put on it, and [X] supplies bits of extra pieces or changes bits and pieces and then it gets given back to service and said "we've done all this work on it, here we are" so..

J-29:19 So is there anything you're dealing with where maybe the information is harder to get hold of, where maybe the correspondence database does date back that bit further, or-

M-29:20 Oh yes, I mean two problems within service, there is a correspondence database (which is a swig of methadone) probing down into them, here comes and email from a customer, put all the emails so someone can go and find the original enquiry and look at everything that's going on. Erm, but not everybody uses it. So there's a problem not because half the traffic or more than half the traffic probably is sitting in somebody's personal email box, some of it is on the correspondence database, and even the stuff that's on the correspondence database has actually been sent and received by a person, rather than [X]. So there's , you know you have to kind of cut and paste stuff into this correspondence database, but then you, unless everybody uses it, and everybody follows the same convention, then you don't, you haven't got that information because it's on somebody's personal email. And therefore analyzing it, you know when you talked about getting information out of it, how do you know whether you've got a repeat problem? Well you don't know you've got a repeat problem because we've got no method of ever searching through and looking for keywords.

J-31:01 You don't track that at all?

M-31:02 I, only up here in somebody's head, because you don't, invariably, it's - "I didn't have that problem a year ago" because there's no, there's nothing that's actually logging that. When I come back to what I said I used at my old company, we used to give keyword, so you used to type down to certain specific, I mean this was industrial lasers, so you would type down to a specific part of that laser, and then a sub category within that and by giving them all key numbers, then you could run a report off at the end of the month for all problems related to

that-you know you could break it down, you could start to get to some sort of recurrence, where you think "hang on a minute" where you've got a sudden peak in the number of things, particular faults, then you can go back and analyze it and you might have to be a fully automated system, but at least you've got the start point. Because we don't do that, we just have, some guys got a problem, so unless somebody remembers that that same vessel had a problem, because nobodies analyzing that, because the databases are not set up to do nice sort of search.

J-32:31 Do you feel that's a missing area?

M-32:25 Oh yeah, from the way I operated before, I know this, I know those were a, we were selling a 50K industrial laser and we were selling a lot of them, so you would have two-three hundred of the same type, but it enabled you, when a customer rang in, you logged it and it didn't matter where you were in the world, everybody used the same database. So you could go and run reports and you could go and have a look at why are we getting, why is North America having all these problems , but Europe's not and Asia pacific's not. Then you could dig into that which would, all the reports would look the same. Then if you back to [X] then if I was going to be proactive rather than reactive, then I would want to know, the only way to be proactive is to have that information in a database somewhere; that you can go and analyze, and you can run a report, again, you need to make sure people have processes in place, and working structure is the same. And I think that's the key thing that's missing at the moment.

J-33:49 Would you like to see that in place,

M-33:52 Yeah! I mean it's something you know, I've talked to my manager about it, it's something that needs to be done, erm and if you've got, you see [X] is a project related thing which is great and we've got, what they call the VST, that it came from, it came back from when they did the work on the millennium, (duck? perhaps: look) back in 98, 99, and it was called VST, vessel support team and its, you know – It was a method of logging a problem and adding to it, but it's not, it points to the correspondence database, so you have to maintain your correspondence database, so you have to maintain the outstanding database, so you have to maintain the outstanding database. Now at least that says here are all my outstanding problems, and there's link across in there, you can put links across to the correspondence which is sitting over here in another database, what you want is everything together. You say "right, this vessel's got a problem," whatever it is, and everything goes in there. All its history, and you code it to that, and when its finished, you close that off, so you can look at open incidents, for a particular vessel ,and then all the closed history. And you can run reports off it, you can get, when you start coding things, so I think that would be a huge asset if you want to be proactive, you've got to have that. Because now you've got some method of going through and picking out the information.

J-35:37 I think what you've said is-you've covered a lot of stuff which is really useful, to me, I know its maybe not that much about email but its.

M-35:46 + but I know, I mean, but that – if you like the limitation with email is you don't have that. The way email is used at the moment, the way we, there's a huge amount of email traffic, sometimes it's too much, if you want to go back. And one

of the things that I would say is the fall down is-customers dealing with persons. In my old company we got over that by having a common email, now there is one here, marine services has [X] but everybody seems to be very reluctant to use it. Now we overcame that in my old company by sending every email to a customer from our global mailbox. So that when they replied it came back into that mailbox. That was easy, we used outlook, not Lotus Notes, but it was dead easy to set up, you just send it from product support, and it would come back into product support, and that mailbox had lots of folders – one for each customer, and everybody's got access to that within the support team, and everybody can see all the traffic to and from; so your personal mail becomes just a memo from your manager, or the internal mails between here and engineering to do with the problem, which you can then just drag and drop into that other one. So in a sense you can differentiate, so all your external communications are filed into one point and always emanate from that one point and from an email point of view that would make life a lot easier. It doesn't solve your problem of searching but at least you now know, at least you can go and look at it. You can have 1000 emails against that one customer, but at least you're looking for something in that date span you know where it is, it's all there, it's not in somebody's personal mail box, it's not in some [X] database or a correspondence database, its all in the one place. Be it an outlook mail box or a lotus notes database.

J-38:16 It makes perfect sense, really, yeah.

M-38:23 Well that's the thing I'd want to start from my personal point of view it's one of the things that I've got kicking over at the back, and I've talked to my manager about this-it's trying to work out how I, how we can achieve that, and then try and get everybody to buy into it and then do it. There you go, so I have a vested interest from where I came from, because I saw the benefits of that from this total random, ad hoc, emails flying around to every Tom Dick and Harry, to actually concentrating it into one place. I saw the incredible benefits of doing that; in terms of email traffic, it stops personal complaints about I've got too many emails. Which is the inherent problem with email, it's a devil and a blessing, but+

J-39:21 When there are, I just want to try and make sure I haven't missed anything on the re-use content of the emails, in terms of searching. Are you, I spoke to, I want to say [X],

M-39:38 in spares? No [X]

J-39:45 I don't want to get my name wrong! Who did I speak to that deals with contractual issues,

M-39:58 On [X], [X] – [X]?

J-39:59 Erm, the names escaped me I have it written down somewhere...

M-40:07 Erm-[X] over at machines deals with some of the stuff,

J-40:13 is he based across the road?

M-40:14 yeah,

J-40:15 It was [X], yeah, he dealt with the contractual issues, the thing is he talked about trying to find, almost an audit trail of who said what and was responsible when for stuff.

M-40:26 Yes because, that's probably if it was recently in relation to the [X]. Yeah exactly, it was to do with some invoicing stuff, I mean that was difficult because it's not all in the same place and I mean, it was difficult to find.

J-40:42 Is that the kind of information that you look, if you search through [X], who said what, would you ever follow a story line, or is it more to do with actual design information?..

M-40:53 I think probably, that was probably a one of, certainly it wouldn't normally be something I would be involved with. It would normally be to find, "we've got a problem", and if we think it was solved on the-if we're on vessel two and we've got a problem finding out that we have, did any body ever talk about that problem on vessel one, it might not have been hit as a warranty issue, but was it ever discussed, I guess; from that point of view it would be a more technical problem rather than an, if you get into an argument you might have to dig back further to say "hang on a minute, [X] said this and you agreed it" "well prove it" now you have to go and search the database to prove that that's what was agreed. But I guess as a normal modus operandi – we're just looking, it's a technical issue, which is why I don't tend to use [X] that much, because the issues come in and we look at it and say ok, this is a simple part failure, no problem, get a replacement part and ship it out. This is it doesn't work according to the specification, go and talk to the engineers, "no they're absolutely right, its, that's not right", we'll come up with a plan, work out how we're going to solve the problem, tell KA how we're going to solve the problem and fix it. So in that – do we have to talk to [X], no. It's not it's not logged. I mean I'm not, that lot at the moment I'm not logging that in [X], so nobody can actually go and find all that history, because its - - I don't find [X] that useful for day to day; I think it probably can be useful but its difficult when you've getting vast quantities of traffic to determine how you're going to–it gets very unwieldy, and especially because that's, if you like I've had this conscious decision that [X] is this project related database related to the main contract, not a service support database. Now maybe that's wrong, but if [X] is going to be something that remains open and it starts to become the service database, then it needs changing. Or it need splitting, maybe you do need a [X] light that becomes the database for-you draw the line at the point of handover, and then you start another, and in service database from there on down. Which is designed for purpose, linked to methods of logging problems and ()

J-43:56 Is it actually then the interface with [X], what you see on your screen that makes it difficult? It the same database kind of existed if you like, but had a different face to it which you looked at from a service point of view and a different face that the engineers look at from their point of view, would that be helpful? and can you -

M-44:17 Yes I think it's a database, [X] is a database which is alright and is fine for sticking things in and retrieving back if you know what you're doing but even if I'm with someone who's using [X] everyday, they still, you'll see them thinking "where's that located" from a service point of view it's not the right format. What you want is to be able to go and see is more like our vessel VST outstanding database which when you log a problem, you go and say – click new, which company is it, who's the customer, who's the vessel, which customer-so

now you've defined it down to a specific vessel or rig, or whatever it happens to be you can define the problem and you can put some stuff below it, but it's not really designed for that. It was designed 9, 10 years ago, but it's that, it wants something that just sits up there, someone clicks on a tab it's open, they can just enter some very specific information, date information is automatic, you pick up the vessel, it populates some of the other fields for you, you define a problem against a set of drop downs, rather than with regular verbage, if you use drop down...then it takes away – people are more inclined to use it, because all they have to do is click in there and its – what's it to do with, you know, it's to do with the propulsion system, so the click the propulsion system, which bit of the propulsion system, you know, this, this, this or this is a sub category, maybe there's three sub – categories, you know – but they don't have to make any decisions because its just clicking on drop downs. So you've got that information in there, they can put a little bit of information in there which is not searchable – the searchable bit is those key –

J-46:35 So from a service point of view you almost want your database to be organized by components by design of the vessel or whatever it may be,

M-46:45 Yes if you look at [X], [X] talks about you know the tendering stage and you know this stage, and that stage and that's within the project, but that's totally irrelevant to the service organization,

J-46:58 That's going down time really,

M-47:00 Yes time, whereas we want it to say, vessel, which bit of the vessel, you know, and you can always set that up because if you set up the vessel, at the time you enter that vessel on to the database you tell the database what equipment its got on board, then you don't get asked to fill in the bits that are irrelevant; because if its only got a DP system on it, that's the only drop down you get. If its got, like the [X], that's got -I doesn't have DP but its got automation, its got cargo management, its got propulsion, you've got all those bits, then what's the problem, you've just got to pick the right bit of that. And it wants to be something that presents a screen to which is very easy and intuitive, it's got to be something very easy that you can just go and click, -if you type in [X], 1st [X] KA, as you type [X] alright, there's [X], click enter there's that, that, that, which no, it's that problem there, sub-system section, bit of verbage in there, you know. You would put in, you'd attach the first email, you'd drag and drop the first email in there, and you'd start sending and receiving emails from that database, and now you've got the history, and you've got key things you put in there, we even used take up the lasers when the service engineers, they had an electronic filed service report and when you sent them, when you dispatched them electronically, they got something which sat on their laptops which came up. They would go in there and put in, fill in other drop downs as to what the problems were they found, and when they emailed back their report back which went into the database, you then saw not only what you thought the problem was, but what the real problem was and you can go and search that, and you've got in service report and it's all tied in there together. At the moment the service report comes back and it comes back on a variety of different methods, there's not standard, they might all use a word document, but it could be written in any method; this was a, you know you haven't got it that you have a bit of

software that ran on the computer and you filled it in and you sent it back, and it got logged. Now you've got it and it's more searchable, you can go and find some history, so it all makes life a lot, you know you can build up on this but it's something that need, that is, you know it can be tailored. The principles are there, but it might be slightly different for marine and offshore and it might be different outside of the marine and offshore but. I've kind of got involved in terms of [X] but erm, a lot of that, coming back to the original things about emails, that takes away a lot of the problems with emails because you control the information flow, and that, is the problem with the emails for the service organization is actually controlling the information flow and getting it into the right place. At the moment it's anywhere and everywhere. And never the twain shall meet. [laughs]

J-50:56 Not an uncommon story,

M-50:59 Yeah it's not, and you know it takes, you need the will power from certain people to say this is what we're going to do, and then you've gotta be really enforce this operation, if you do that, you can start looking for that information, you can start looking for your trends you can start looking for that information.

J-51:23 And that's something that's missing at the moment,

M-51:24 Yeah, I wouldn't know where to start, as someone that's only been here for what now, 10 months, to find information I have to go and ask somebody where is that information, and some people have not got that information. I'm very much, I'm on the J drive, there's a marine and offshore folder in that, there's bits and pieces, everything's in there. I've got nothing on my computer, working documents I might be using, but anything that's a published document goes on there, and anybody can get to it. Now a lot of people are still keeping there stuff that there working on, where is it, well it's on my H drive, or it's on my C drive. You know if everything is in that one place, then you've got some control, but that's only because of where I came from before, that's the way we worked it. To make sure that everyone had access to a key point. Where it's a database whether it's a sub folder somewhere doesn't really matter, so long as it's in one place, yeah. With the email thing, it doesn't matter whether it's technical data or emails, if you're going to do it with emails as I've said you also have to come up with a strategy of also saying emails are no longer-, no more than five lines, I can't remember what it was, somebody a few years ago gave us, several years ago, something like emails should be no more than 10 or 15 lines, it was something like that, that was limit, that was the extent of your email. You should never have bullet points and numbered things, in there, under normal circumstances. With the service thing I would give exceptions to that in the sense that it's, if you've got five things you want to ask the customer to do, and he's out on a boat which has some pretty crap communication system, then it can be erratic so, you don't want to be sticking a megabyte attachment to it you want to put, raw text which is quick and easy to get there and they'll come back with the answers. But if you've got that information back, if you've got some sort of support database you can extract a) that email is in there but b) you might come out and extract some key information from that and put it into that database which makes it more searchable.

J-54:25 good,

M-54:27 Has that answered all your questions, I feel we're digressing, we've digressed quite a lot to side issues but I kind of got the impression that you were quite interested in those.

J-54:34 Well, to be honest the questions that I can- + some of the stuff about email that we're interested in is what you've - reuse value what is it to people, kind of from your answers I can tell that I think I've found out what I need to find out about how much you use email.

M-54:57 Re-use of emails, I've just, I've got an engineer on a vessel out in the gulf, and he's got a problem, and I went through trying to find an email, and its only been going on for two weeks, and I've got a huge raft of email, but in the middle of that is about 20 emails which you don't want to read about, which is all me talking to the agents, working out – has he got a visa, yes; oh is his visa still valid?, you know to and from emails they are totally irrelevant to the technical problem but they've taken up a third of the email traffic, is just to get that guy on the ship. The technical stuff you know is the other two thirds, or maybe it's a half of it. Simpler ones could be. And then you've got the problem that then hits you with the side bar in the middle of that email trail which is all nice, well you think that is all to do with one problem, and then you find "ooh by the way," then you've got a second email going on a second problem.

J-56:05 In the same email

M-57:07 in the same email, which is within service a major problem. I mean I've come across it a few times since I've been here, recently – as I started to get more involved in day to day issues and it was certainly a big problem at my old company. That you would just start off with I've got this fault, and half way though it they've stick in another problem and you'd then have to actually take the discipline, you've then got to actually split that and respond to that one with this email trail, and then create another one then. Now a lot of people don't, so you then end up with this widget failure email which is nothing to do with the widget failure it's to do with some other failure.

J-57:00 There are some amazing, subject lines I've seen in [X], in the email set from [X] that have got nothing to do, and even the things below the emails have got nothing to do with them, you know things that have got reply on them and the text copied down below has nothing to do with either of the parties emailing as far as I can make out.

M-57:21 yeah I mean I think the email. I mean I think again a lot of that comes down again to email etiquette and teaching people how to use email,

J-57:32 Which is not done?

M-57:32 Which is not done, they don't even teach you how to use Lotus Notes when you join here, I mean there were others – that's a side issue – but I mean there's the email etiquette ; I've seen it here, I mean they had (in my old company) they had a very strong set of rules and I would tick off the guys in my group and say – "don't do that, do this" and bit by bit you can get people to keep their emails. Make sure the subject matter is relevant, if somebody comes in with a side issue on the same – change it, don't just reply. Change the subject matter, get rid of all the crap below it and just leave yourself with the new subject matter, reply

and change the subject matter to it ,and then you've got your new trail going. Invariably that doesn't happen, so when you come to search, whether it's [X] or somebody else's email, whatever it is, if the subject matter's wrong, you're stuffed.

J-58:41 I think yeah, and I think this is the difficult bit for us from a trying to 'sort email out' or as an academic problem how to create better solutions is difficult because it's external to the company, even if you fix your email practices up within one company, if the people that are replying into your emails, and who are sending email in have slack practices.

M-59:03 But yes, even if they have slack practices you can, as long as your practices are tight, and everybody knows if there sloppy. If the onus become upon you to control that email, then as with the example just now when you change the subject matter, and reply to him about the such and such a problem – it's a complete subject matter change, it's his email, but you've changed the header. Now you've got, you've actually taken control of the email, so we [X] want to invoke this methodology on our email traffic and if you set that one up, email comes in which doesn't adhere to that you can make a very subtle change, without loosing the thread, but invoking your methodology on there which makes it traceable and very specific to a particular problem. And get rid of the dross that's underneath and making sure you don't copy the wrong people and talking away the internal emails and making sure you control it. And that's a lot of that which some down to email etiquette which comes down to searchable and how much is re-useable.

J-1:00:27 And how much of your service emails do you think are reusable? Because we've come from a point of view of assuming or hoping that / to prove that the design information within an email corpus is reusable for future design work, but whether the service information-what problems do you think-

M-1:00:49 In all the email traffic a lot of it will be dross to do with order numbers and getting the guy on board the vessel, and in some cases that's the only thing that email trail, the only bit of any significance technically will be I've got this problem, right you need an engineer. Then you spend 20 emails getting the guy out to site and the only feed back to that is his field service report when he finishes it; so you open it up with an email, and you're closing it with a word document. And only if you, if you back to this scenario where you're having this database where you open it up, then the opening up is you cut and paste his problem into this situation, this is my problem, all that email dross about how to get him on an airplane to get him onto a support vessel to get him onto a ferry to get him onto the rig or whatever, totally irrelevant technically, It can be in anybody's email box, it doesn't really matter, it is totally irrelevant, once it's done, you can delete it. But you've got the opening gambit, then you've got the field service report, then that's into that database. And that's the only two bits of information, this is my problem, this is how I fixed it. And most of the other dross in the middle, this one at the moment this on going problem I've been working on recently, yes there are some bits and pieces going backwards and forwards, but they're mainly - just because emails a way of doing it. If we could get on the phone, and sit on the phone for an hour, that may be the way of doing it, but invariably it's, "can you go off and do something" which he can't, it's not an instant thing, so you've kind of got to email him about it. It could be

a phone call, but you don't catch a phone call, in essence from a technical point of view, if you know what the problem was, and you know how you fixed it, those are the only two bits of information you need, to go back and look at – "did we have that problem before, yes we did, how did we fix it, we did that" some of the how you got there can be useful, but then again not all of that email traffic is useful – if you've got some method of extracting the relevant how I got there out of the email, and drop it into the database, then at least you know how you got from a to b. But invariably the field service report lets us capture, because they tend to log it by what they do each day and the captain signs it off, on the timesheet. So invariably it says got to the ship, did this, tried that, did that, did this, fixed it. So in essence that should, a good service report if its done, will give you the history, whether he's writing what's in that email trail or not – in a way it's his prcis of that. Tried this, tried that, that didn't work, tried this which gave me this result, tried this, fixed. So you've got your statement of problem, how you fixed it and essentially a praise of how you got there. And if you've got that email somewhere else you can always go and look at the detail of the email, but invariably it's not that relevant, most of the relevancy is in the statement of the problem and a good report. Again, discipline of how they do it so, looking at what's in those email trails, what would we want to go back and search, actually none of it. You could, the ultimate to me, the ultimate situation is the email is just a method of communicating, which is in a lot of cases easier than a phone call to some installations, and if you do it verbally you have no electronic means of capturing it at any rate – so if it's done totally verbally, engineers in, talks to somebody up in here, they talk about it for 10-15minutes, four times, solve the problem, there is no email trail. So you almost work from the premise, from a service point of view the email trail is just how you got there, and at the end of the day you can delete it. Because in a way that shouldn't because it can be done verbally and there's no electronic copy of that verbal conversation then you can argue that if the verbal is discarded because it's never stored, if you see what I mean, then you could argue that the email can be discarded. Therefore you work from the premise that there is nothing useable in historical email information, it's all on - this is my problem, this is how I solved it. And if it's not solved by a field service engineer, then the solve bit on your database is filled in by myself of one of the other guys in the engineering group who says, who praises effectively those emails, and says this is how we solved it. I solved it on the phone because I asked the customer to do this, he says it was that, I asked him to do that; he came back and said fixed it. There it is, its not in the correspondence database, yeah there were some emails, maybe you want to keep those emails, because it's shows a bit more, but if it's on the phone, it's not captured at any rate, so in a way you can, you know put away the email traffic, the historical technical from a service point of view should be relevant, because it should be captured somewhere else on a problem statement whether it's fixed by a service engineer or not. You know as I say if you've got a service engineer how goes out in the field, it starts with and email or a phone call but it ends in a word document.

J-1:07:48 Yeah, I can see exactly what you mean,

M-1:07:54 Which is where the service organization differs totally from the way that the emails in [X] are used during contract negotiation, sort of contract handling,

stuff like that. We're using [X] as a historical document – I don't always find it easy to find the information I want, but most of the information we want from a service point of view is actually software, drawings, and they are not within [X], they are two specific controlled areas, under their own control so you can get that information, so as long as everybody follows the procedures, the guys know exactly where to go to get it, so they know that they'll get current, not archive. So if you like [X] is irrelevant, [X] is not applicable to service, and it's the way, what we've got, doesn't work and I would argue that there is, I know a much better way of handling that email traffic and the data you've got from that email traffic, how you solve the problem, at the end of the day, I had a problem, how did I solve it, erm, and that ability for people to look at that problem, every month you can run through and look for recurring problems, that gives you the ability now to be proactive and find it. You know some of it we keep getting lots of problems but in the grand scheme of things it's just you know.

J-1:09:51 Keep on getting them, keep on fixing them?

M-1:09:52 You get that, there is no fix for that problem, because humans are humans and they do things, but if it's a you keep getting the same component failing, that's the one you're looking for. And it's only as good-we have no method – it doesn't matter how good your email searching is, unless you have a database that ties things down to specific areas within the vessel, propulsion system, the vessel management system or whatever it happens to be. Sub –sections down there, as low as you think you need to go and it maybe down top card level. So within the laser we had, the cooling system, the power electronics, the control electronics the laser head, which is optical. And then within that optical laser head you have- there are a myriad of components which could be the failure mode, and as long as you, if you went down to the point of saying yes it was the front optical – those were separate points, so you could look then, and of course you said it was the laser optical, front optic, down to a specific component, but it was a critical component, and it was one that they'd got the coating wrong on the optic, so a repeated failure, and we had them, and you do that and you get that from analysis. Well we [X] have no method at all to do that analysis now, and if you could get that analysis, you have that discipline in the database in the way you use it then going back into emails and looking for historical information or getting technical information out of them becomes irrelevant because they're just a means of getting the information. It's not the be all and end all, we use emails, we use telephone. ++ That's probably thrown a few things in there.

J-1:12:16 It's s good, it's another perspective on what's necessary.

M-1:12:21 Well I always think they

J-1:12:25 To build up the whole picture,

M-1:12:26 Yeah and I know because I've been in the service organization before. A lot of companies look at the manufacturing side or the project side (if you like) not so much manufacturing here as what I was used to the previous 19 years, but -there is a service, you have to understand what services needs are and how, it's no good trying to shoehorn [X] to be a service tool because it isn't, it might be a great tool, it might need tweaks to it as a project related tool – but it certainly isn't a service related tool. I can't see any good use for it, and standard the

sort of databases that are going on lotus, aren't, you know as they are, are not the ones you need. You need something which is very much honed into, and it might be different for marine and offshore, the concept will be the same for the other organizations we're working for but the detail within it will be different for each one, the concept should be the same, but the detail will be different because marine and offshore will have a different structure to dig down to the problem, but essentially the concept should be universal. It's something I'd like to work on because it's something I see as a problem here,

J-1:14:09 Well I hope you get the opportunity to-

M-1:14:10 Well again I don't know how far your remit goes in terms of- you're going to go away with all this information and come up with a report which you'll submit to [X] and everybody will go "great" and then they'll all go how are we going to do this then

J-1:14:28 Yep, that's it, there's-what you say is only as useful if somebody wants to implement it.

M-1:14:38 But I mean from your point of view you get a different slant, you just said, on how emails are used, and I think emails, apart from what I would call personal emails, in the sense of day to day running that you normally get from your manager, they're internal emails– take those out of the equation because they're company wide and can be tailored to suit from my point of view. The criticality of emails is how you deal with the customers, and by and large it is either an email comes in or a phone call come in and you've got a log of that problem. And as long as you log it, and do things in a methodical manner, at the end of the day become irrelevant.

J-1:15:38 Good, good, that's really helpful,

B.6. Software Engineer

This is the transcript of an interview of [X] by James Wasiak and Craig Loftus. The interview was conducted on 2008-05-13 it is 19:35 in length and was transcribed by Craig Loftus on 2008-05-30.

B.6.1. Speaker key

B [X] – Software Engineer

C Craig Loftus (Bath)

J James Wasiak (Bath)

B.6.2. Transcript

J-00:00 Okay, right its working, thats always a good sign. So, I'll start from the top then. Could you give me a rough idea of how much of your day you spend working with email? And what kind of things you're using it for?

B-00:21 Well I don't actually use email that- Because my role is mainly on the software side, I have very little contact with the customer. Perhaps people like [X] and [X] and even [X]. Because its the application guys that tend to communicate

with the customer. And define what changes and so on, what requirements for us to implement in the software. So in that sense my use of email for customer information was very small.

C-01:01 So were you perhaps reading the emails rather than sending them?

B-01:04 Yes. Thats rights when there was I got sent emails saying this is the requirement for this interface or this change. That was most of the main and so my interface was really with our engineers rather than with the customer.

J-01:23 Yeah, thats fine. And did you- Do you ever use email internally to speak to the other engineers or with [X].

B-01:33 To yeah. To respond to their requests and if I've got anything to say.

J-01:42 Do you- Are you co-located? Do you sit near them in the office?

B-01:45 Yeah, that's- I mean, I think the idea- There- The main team together because it was the first one they'd done and it was a large one- Project. So, yeah.

J-01:58 So what- Obviously you'd speak to people face-to-face. How much of, kind of, the communication would go through email? Why might you use an email to speak to an engineer?

B-02:14 I think if- For record purposes. If you want to record it. That would be one reason and if they're not there.

C-02:26 So if they can't reply immediately then they can just think about it later.

B-02:29 Yeah. Thats right.

J-02:32 And did you have any relationship with [X] through email?

B-02:39 A little bit, yeah. My- it was quite a large contract even on the software side and I only joined the department and that was my first- After a few months in house training. So I was trying to learn their systems and tools as well as trying to work on it at the same time. [X] was, I think to some extent- Because of the shortage of resources [X] was probably given too much- He was- Because we employed a consultant on the gas side because we didn't have any knowledge.

C-03:29 Is that [X]?

B-03:30 Yeah, thats right. Thats [X]. And on the application side it was [X] was going to look after the gas application, cargo and the machinery side of the ship and [X] was going to look after the power management side. I think it was- We could see that [X] was quite heavily loaded so they ended up- on the machinery side, he got some help from [X] and yes, so my interface with him- I actually worked on the Power Management and the Machinery side of the software so that was interfacing to [X] who was the application- and [X] I think my interface to him wasn't that- Because I wasn't actually working on the gas or cargo handling.

J-04:42 So they- The people you worked with the most would probably have been [X] [sic] and [X].

B-04:48 Yeah.

J-04:52 Okay. Thats good. I should give you an opportunity to ask any questions, if there are things I've missed, as I go along.

C-04:58 Were you co-located with the-

B-05:05 Yes. There are 4 of us in a bay, its [X], [X], Myself and [X].

C-05:11 That was one group. Were you in with anybody else involved with the project? Or was it just-

B-05:15 Yeah, [X] was involved but he sort of sits- Its not- Its only a couple of bays away. And then theres the HMI, again- and theres some other people like [X] who has helped quite a bit. He's got- he been in the Company a long time and made a lot of software (@05:40).

J-05:45 If I can try to come back to email a bit. I mean, I get the impression that email wasn't maybe that useful to you as far as, kind of, design information goes. So maybe some of these questions theres not much of an answer to but can you think what kind of tasks that used either sending or receiving email for?

B-06:15 Yeah. I mean- Quite a lot- I worked on the link software, for external links that the software- our system- Our software was communicating with and so, if there was external link interfaces and things like that I would have got them through email and in a few of the cases I had to communicate with the guy responsible doing the other end, through email.

J-06:45 Who was that?

B-06:49 Theres a fire and gas link and that was a [X].

C-07:01 So is that exchanging the input output schedules?

B-07:07 And any problems that we were trying- Because that was a complicated protocol and just trying to understand the documentation that they'd given us and any problems that we had. Just trying to sort those out, sending him requests saying "this is happening. Can you- Is my assumption correct? Is this what I need to do?".

J-07:41 Can you think then- If you imagine you're sitting at your desk and you decided to send an email for some reason can you think of few different examples of reasons that might prompt you to do that, to need to send one?

B-07:59 I think- Yeah, if I've got a problem and especially for external- Then thats the main means of communications and for internal stuff, for recording purposes to make sure there is a record of what- If there is a problem, or whatever, so that somebody does take action.

C-08:31 When you say there is a need to record it is that from a quality management perspective, if you want- To get the certification of the software? Is that why it needs to be recorded or just?

B-08:34 Could be partly that. Could be part of it yeah.

C-08:42 I suppose another aspect if you perhaps weren't using emails that heavily in relation to the project- How did you find [X] supported the other aspects, in terms of handling the specifications for your software.

B-09:03 Yeah, I guess [X] is quite a useful tool because everybody is- I mean, I didn't actually use it that much, apart from just looking at information, what was recorded under there. Actually putting stuff in, I did very little of that. But as a tool- Making sure that you've only got one version- You can't have multiple people having different versions. Its a good tool.

J-09:30 Did you do much retrieval from [X], then. If you weren't putting a lot in.

B-09:36 Yeah. Yeah, the main bit was, I was looking at stuff that was in there, rather than putting stuff in.

J-09:41 And was it- Is it easy to use and to navigate through?

B-09:45 Yeah. Seems relatively- Although it does seem- I mean, theres a lot of information in there. Emails and stuff.

C-09:54 About 15,000 emails in there. [laughs]

J-10:01 Yeah. How did you- Have you ever been given any kind of guidance or instruction on how to use email? If you like, good practice for how to use it. And do you feel [X] is good in how it deals with that.

B-10:21 No. Probably not actually. I can't remember anything.

J-10:33 And did you say you'd joined [X] fairly recently.

B-10:37 No. I mean this department. I've worked with [X] since I left University. But I've spent 25 years in the metals environment and just, last 3 years moved into Marine.

J-10:50 Right, okay, thats clear. I won't ask you about what you did at the previous Company then. I have a question which asks "Do you feel that email, you know, if it particular aids or hinders your work?" I'm guessing you're not particularly overloaded with email, which maybe some people are?

B-11:19 Yeah. I think some- People interfacing with the customer and that applies, I think, to the application engineers more- than probably, yeah, more. I mean, just generally, one of my colleagues who works for IS now, Information (@11:42) and they're complain about the fact that- storage and so on. Some people, their mailbox sizes are so massive so- managing it from that level. But I've not had that sort of problem.

J-12:01 Right. So would you- You say in general of- From us looking to change the way email works or the way work with email is probably not directly of that much consequence to you?

B-12:16 No probably not. Yeah, more sort of the application people who have a lot of interface with the customer.

J-12:23 Yeah. Thats quite alright.

C-12:26 Do you think- Does the current system allow you to understand the relationship thats going on with the customer or- Do you get a view on that through [X] or do you just get communication directly from Pete Makepeace for example or the application engineers.

B-12:48 Yeah. [X] is there so you can read it, if you've got the time. So all the information is there, although I think in some cases some of the people are possibly not putting in all of the information into [X] maybe that they should be.

C-13:06 I think that theres somebody waiting to get in here, perhaps? We just hijacked this meeting room, so-

B-13:11 Oh alright.

J-13:12 I can check, I'll check with them. I had two more things I wanted to ask you.

C-13:16 We can go through to somewhere if- [James gets up and asks, returns satisfied]

J-13:31 When- I was interested in how much you maybe use information thats already been created. Works thats already been done when you're carrying out design? Whether you look back on old documentation or at previous project and see if you can reuse information, save yourself some work. If you do that much, and what kinds of information that is, or what kind of documentation?

B-13:59 Yeah. I think I'm more inclined to- If things that you've done in the past- Rather than trying to reinvent the wheel. I always tend to look back and try to use something thats already been done rather than rewriting it for the sake of it.

J-14:21 Does that apply to a lot or- When you come to design anything would your first action always be to go and see has this been done already or how do you know-

B-14:32 I mean, I think that most- I mean, quite a lot of these softwares that we have to do is quite standard. Quite a lot is configuration and so on. So, yeah to some extent, it is, yeah, rather than to try and keep reinventing it, its best to use whats already there.

J-14:57 And what kind of- So- I'm trying to put myself in your position- You come in to do a design and you know that something similar has been done in the past but you weren't involved in it yourself but you want to find out about it. Do you- How do you then find out about that design? Which channels do you use?

B-15:15 I think it is mainly talking to other people who are- Who have worked there longer and have wider knowledge, than say, me.

J-15:26 So they're the link in to find- And would it be possible, if those people were- If you were set a task and everyone else- You were working on your own, everyone else has gone on holiday for a few months (Hypothetical) and you're left to do this task. And someone says "The good news is, something similar has been done before". Would you be able to find records of that?

B-15:50 Yeah. Because, I mean, the software is held- I don't know if you've heard of [X]. All software that on Marine jobs is held as [X] projects on a server and it gets archived. So, I mean, I haven't gone that far back- Just a few years back but- So its on a server and so long as by talking or by other means that you know that something similar has been done then the software is there to be retrieved.

J-16:27 And you would look straight at the software. Would you want to see any support documentation around it or discussion.

B-16:32 Again, I think a lot of that is in [X]- Yeah, thats in [X].

J-16:37 And can you foresee needing to look at correspondence to do with that- emails-

B-16:43 Probably not.

J-16:45 Thats fine. Yeah, thats quite okay.

C-16:52 And its not a bad thing we're just trying to- We need to find the way the different engineers are using email.

J-16:58 Yes, theres no point coming up with a solution to a problem which doesn't exist. The other thing was, I'd wondered if you'd had anything to do with service or warranty. When problems crop up if they ever get sent to you to-

B-17:10 No. I haven't had any contact-

J-17:15 Okay, thats fine. Good. Yeah, thats all I have to ask.

B-17:20 Oh okay.

C-17:24 Are there any general feelings you have about the way [X] handles its information that you might particularly like to share. Not on a specific level but general architecture- If you think works well and all the information is handled? If there are particular processes that just seem a bit chaotic?

B-17:46 Can be chaotic, yeah, sometimes. Because, just, the volume of information is just growing. And I think from I.T. end from IS, I think they've got large problems just providing support and storage and keeping- Saying that we've got [X] projects just keeping our input- I mean for- On this [X] theres going to be 6 ships. Theoretically they're supposed to be the same but they never are in practice so you're going to have different versions for each ship and trying to record what the changes are and so on is a big task.

B.7. Volunteer A

This is a transcript of an interview of Volunteer A by Craig Loftus. The interview was conduction of 2010-07-06 it is 03:37 in length and was transcribed by Craig Loftus.

B.7.1. Speaker Key

C Craig Loftus

A Volunteer A

B.7.2. Transcript

C-00:00 Just to save me writing notes. I hope that wasn't too arduous.

A-00:05 It gets really confusing... like... I don't know how much of the actual jargon you needed to actually... I wanted to read through them before I answered the questions completely even though you don't really need to know much of the ins and outs of the overall.. [inaudible]

C-00:25 First of all some questions, some specific questions. What degree stream are you in, are you in Aero?

A-00:30 Aerospace

C-00:30 Aerospace, okay. Do you have any familiarity at all with any of the hydraulics or power electronics they were talking about

A-00:39 Not really... I... That's why I spent a fair while on the first couple to get... to get a better understanding. There's a few, erm, sort of like acronyms that confused me... trying to figure out what they meant... but yeah

C-00:56 Okay. Have you worked in indu.. [mumbles] in industry at all

A-01:00 Erm, Yeah, I spent a placement with BAE systems, although that was on, like erm, head up displays and stuff so it was nothing to do with [electrical] systems

C-01:10 and was that a year long placement?

A-01:11 Yeah, yeah

C-01:16 Could you indicate how you found the task, do you think you answered all the questions... fully satisfied?

A-01:22 Yeah, I think so. There was times when it says such as erm, describe the 3 key individuals, I sort of said what they did and that sort of blended into question 4 because it was the responsibilities... because obviously the individuals were from the different...

C-01:40 ... belong to the different... Were there any of them you found particularly difficult to answer, or you struggled with some of them?

A-01:47 The final state was quite hard because in the last couple of emails they were still coming up with issues. Like the oil lubrication oil type so it was quite hard to say what the final state was. They said, like the control system they were going to wait to tomorrow... so there wasn't really a final state so I put down what I thought.

C-02:14 And did you trust the information in email? Were you happy reading and just...

A-02:22 The emails where the big blocks of text they seemed to know what they were talking about and there was that much detail involved that I did just assume that it all made sense.

C-02:35 Did you develop any ideas about why I might be doing this?... At one point you mentioned whether the foreign language breaks were intentional or not?

A-02:54 Is it something to do with how well information can be transferred between in a project, misunderstandings and things. When several companies are involved. Especially when they start referring back to previous emails then fitting [unclear] and then saying some of this got lost. It does get a bit confusing.

B.8. Volunteer C

This is a transcript of an interview of Volunteer C by Craig Loftus. The interview was conduction of 2010-07-21 it is 03:15 in length and was transcribed by Craig Loftus.

B.8.1. Speaker Key

C Craig Loftus

V Volunteer C

B.8.2. Transcript

C-00:00 So, first off, you're doing and MSc?

V-00:09 I'm doing aerospace.

C-00:13 Do you have any familiarity with the hydraulics or power electronics that they're talking about in the email?

V-00:19 No, but actually I'll be using some of electronics in my project dissertation, but its not a major part of the...

C-00:31 Have you worked in industry or done a placement?

V-00:34 No.

C-00:38 More generally, how did you find the task? Was it arduous or?

V-00:43 Yeah, it was like, the email interpretation part was good because I think it will be helpful later on in my careers [Always learning!]. So it was really good to read some engineering task and understand it at the end of it.

C-01:00 Did you find them difficult to understand?

V-01:03 In the level of the engineering application, the technicalities are quite, I mean, really good. Understanding for a student, the details which they include in their email and the technical problems they discuss were highly technical for me. But generally they have put the details really nicely, so that I can understand.

C-01:30 Did you find the extra information through the links? Did you use those?

V-01:34 Yeah, I used those, and it was really helpful because I didn't know what was the reduction gears, the details or the reduction gear stuff.

C-01:45 Do you think that you answered all the questions to your satisfaction, fully...

V-01:49 Yeah.

C-01:50 And were there any of the questions that you found particularly difficult or that you couldn't find the details to answer them as fully as you would have wanted?

V-01:58 Not really, there was one question... the difference between the last emails between then, so I was thinking for some time what would be the difference, the technical difference or the way they put their emails?

C-02:22 Did you sort of feel certain about the information in the emails and in the descriptions, did you find any inconsistencies or did you trust the information?

V-02:38 Yeah, I pretty much trusted the information.

C-02:43 Last questions. Can you suppose why I might be doing this study, or what do you think the end goal might be?

V-02:53 Considering what you did with me just now I think its something to do with intellectual and interpretation levels of engineering to understanding technical details and put them on paper and maybe yeah, because at the start you tested my memory and mathematical stuff.

C-03:15 [I go off on one about my research and then the interview ends]

B.9. Volunteer D

This is a transcript of an interview of Volunteer D by Craig Loftus. The interview was conduction of 2010-07-22 it is 03:58 in length and was transcribed by Craig Loftus.

B.9.1. Speaker Key

C Craig Loftus

D Volunteer D

B.9.2. Transcript

C-00:02 So you're a... what year are you in?

D-00:04 I'm going into my third

C-00:06 Going into your third, and what stream?

D-00:07 Straight mechanical

C-00:11 Do you have any familiarity with the kind of hydraulics or power electronics?

D-00:15 Not at all.

C-00:16 That's okay. And I guess if you're going into your 3rd year now, have you worked in industry

D-00:22 No I've decided not to do a placement.

C-00:23 Have you worked in industry before?

D-00:25 No.

C-00:26 How did you find the task?

D-00:30 It was pretty complicated to start with but I guess because I'm an outsider looking in on it, it kind of complicates it but I kind of understood it as I got through and kind of understood what they were telling each other. And what they were trying to get from each other. It was tricky.

C-00:55 Did you find that in the emails they expressed themselves quite clearly, or?

D-01:04 Well, I don't know, its not really a language that I would use, or not one I'm familiar with.

C-01:10 In that regard did you the...

D-01:12 I found some where a lot more, a lot easier to understand than other peoples

C-01:17 Did you find the descriptions of the different terms helped? In terms of understanding?

D-01:21 The highlighting thing?

C-01:22 Yes.

D-01:22 Yeah, yeah they helped a bit.

C-01:28 Did they really help, or did they get in the way more than they helped? Were you clicking on lots that weren't actually of...

D-01:37 Yeah, I mean, I clicked on the ones I was a bit confused about or I just needed a bit of clarification.

C-01:43 So you just limited it to those, you didn't click on everything... [affirmative]

C-01:46 Do you think you answered the questions to your satisfaction? Or did you run out of time?

D-01:53 I wouldn't say I did very well.

C-01:57 Were there any particular questions that were difficult to answer?

D-02:00 I didn't really get what the last bit was and also that... I didn't really understand what changes they fully introduced.

C-02:18 That's fine. Its not a simple email thread at all... Part of the reason this work is being done is that this is what a lot of engineering records look like now and its a bit of a disaster. And people do come into the project a couple of years after its started. Like you who are starting in engineering in two years, you might be asked to start a project half-way along and catch-up on an issue or something and only through an email thread. Its not very fun.

D-02:55 I recon, if I had a bit more time, if I'd studied about more to do with what they were talking about it would probably go in a bit easier. Not necessarily that project, but I don't have a clue about what 25 micron filters are. All these [x] are. And how it all fits together, I couldn't really understand the schematic drawing. It was too much to take in really. Maybe in a few years time I might understand it a bit better, and I'd be able to look at that and then take in what they are talking about a lot easier.

C-03:51 Okay. Do you have any questions for me?

D-03:56 Not really. What's this for?

C-03:58 [I explain the project and sessions ends]

B.10. Volunteer E

This is a transcript of an interview of Volunteer E by Craig Loftus. The interview was conduction of 2010-07-22 it is 01:48 in length and was transcribed by Craig Loftus.

B.10.1. Speaker Key

C Craig Loftus

E Volunteer E

B.10.2. Transcript

C-00:04 So you're a masters student?

E-00:05 Yes

C-00:06 and what degree stream are you in?

E-00:08 I'm doing automotive engineering.

C-00:11 Do you have any familiarity with the kind of hydraulics or power electronics that were in the emails?

E-00:16 No. Not at all.

C-00:18 Okay. Have you worked in industry? In engineering?

E-00:24 Yes, for 2 months.

C-00:26 So was that a placement?

E-00:28 Yes it was a placement from my undergrad. college, for 2.5 months.

C-00:35 And more generally, how did you find the task?

E-00:39 I could understand a bit at the beginning of the emails but as and when I went down the thread it was turning more into technical stuff which I had no clue. So I rather didn't give too much importance to the email that lead to understood that some people, or I could understand from the emails sent across, who was in with which company and had an idea of what it is and some people who responded and could understand what their stuff was but I couldn't understand anything technical or what the email said.

C-01:18 That's okay. Do you think you answered all of the questions to your satisfaction?

E-01:22 No. I think only a couple of them. The rest were, basically since I had no clue, what I could grasp from the email.

C-01:30 And which were the questions that you found particularly difficult?

E-01:35 Especially the fifth and the second question.

C-01:48 Okay. Cool.

B.11. Volunteer F

This is a transcript of an interview of Volunteer F by Craig Loftus. The interview was conduction of 2010-07-27 it is 04:00 in length and was transcribed by Craig Loftus.

B.11.1. Speaker Key

C Craig Loftus

F Volunteer F

B.11.2. Transcript

C-00:00 Okay. So you're a masters student?

F-00:04 Yes.

C-00:05 and what particular stream?

F-00:09 I'm doing a masters in aerospace engineering.

C-00:10 Do you have any familiarity with hydraulics or power electronics that was in the corpus?

F-00:18 [No] (unclear, answer assumed to due lack of further detail)

C-00:19 Have you done any work experience in industry, placement or time working?

F-00:26 I haven't worked but I have been too industries as part of my bachelors

C-00:33 Okay. As part of a placement for a few months or visiting?

F-00:37 We didn't have something like a placement 'cause I did my masters in India and as part of our curriculum that we do a project at a company and spend at least a weeks time getting familiar with a company.

C-00:56 So like a collaboration project?

F-01:00 Yeah.

C-01:01 In terms of the task, how did you find it?

F-01:05 You mean what I was doing now?

C-01:07 Yes.

F-01:08 I didn't find it... pleasant because it wasn't what I'm used to and I didn't find it to be simple to follow.

C-01:31 Okay. Were the... in terms of what the questions were asking and the interface, was all that clear? Was it just the content that was difficult to interpret?

F-01:46 I think they could have brought it out in a more organised way, possibly, me not being in the industry is why I couldn't follow. Maybe it is just something among them that they understand everything that they have mentioned.

C-02:06 You mentioned that you skipped a particular question, which one was that?

F-02:10 Fifth.

C-02:11 Okay. And was that because you ran out of time or you couldn't see a difference?

F-02:16 Kind of time, and it was just filled with a lot of technicalities that and it was pretty big.

C-02:25 That's fine. Other than that were there any other questions that you found more difficult than the rest?

F-02:31 No, they were pretty alright.

C-02:33 And do you think you answered the other ones satisfactorily? To your satisfaction?

F-02:36 Well, I'm certain I would have taking them more seriously had it been a more serious affair, I think satisfactorily question 1, the other 3 that I did more straight forward answers than descriptive nature.

C-03:09 In terms of what you've been saying the sort of goal of my project is to help people interpret sets of emails that they're not very familiar with because as you say the people exchanging them are familiar with it and would add all the detail in that you would need to understand it. But that is a real problem engineers are facing when they go into industry. You might start a project 5 years after it has kicked off and you're expected to learn about an issue from the email exchange like that. So the projects looking at how to help people sort of interpret documents, that kind of stuff. Okay.

F-03:47 So at the end of your project are you, including that it would be a lot more simple for people to catch on even it is 5 years later.

C-04:00 Yeah, that's the hope. The other participants are getting a set of emails augmented with descriptions for the domain specific terms and context specific terms. So that's the abbreviations and technical terms would have definitions with them. So that is a very practical proposal it sort of... I'm trying to see if there is any improvement or whether it has a negative... it might just end up getting in the way of people interpreting.

B.12. Volunteer G

This is a transcript of an interview of Volunteer G by Craig Loftus. The interview was conduction of 2010-07-28 it is 06:29 in length and was transcribed by Craig Loftus.

B.12.1. Speaker Key

C Craig Loftus

G Volunteer G

B.12.2. Transcript

C-00:12 You're an MSc student?

G-00:14 Yes.

C-00:15 Which degree stream are you on? Are you aero, mechanical, design?

G-00:21 I'm mechatronics.

C-00:23 Mechanics, okay. Do you have any familiarity with the power electronics or hydraulics in the emails?

G-00:30 No. Not... I know what it is about, like ship and motor and oil to lubricating them but because its involving three companies and many people involve, that's why I need to its unclear. But I'm not familiar with technical things of it.

C-01:05 That's fine. Have you worked in industry at all? A placement year or...

G-01:09 Yeah. But not in this area?

C-01:10 Could you give me some... where did you work, and how long?

G-01:16 Just in my bachelors I'm studying electrical and electronic engineering so my placement is about power distribution and its very electrical side. Its not that mechanical.

C-01:39 Okay. You've indicated that you found the task quite difficult. Is there something specific you found difficult about reading the emails? Was the language, the English a problem, or?

G-01:57 English... not mainly. Its because I don't know. I mean I had no idea originally about the company and the people and the whole thing, I don't know at all at the beginning. So I'm not familiarised and it takes time.

C-02:32 Were there any questions in particular that you found difficult to answer, or that you weren't satisfied with your answers?

G-02:57 [After a lot of muttering...] Maybe the last one. The last one I found that... It was the last question asking about the difference and its actually, the first part is a repeat... so it seems that the answer is very obvious but of course its not just copying, that's the difference. That's why... I don't know how to say but they are more or less the same level of difficulty. Yeah... and actually I was wondering if this one is just measuring the post? As in describe the personality or?

C-04:03 Well it was describe their role within the thread.

G-04:10 [Unclear] Maybe the 2nd one, "describe the final state", so the final state as I mentioned, I don't know the technical side of that so I only no the surface, what is mentioned there and just copy that.

C-04:40 Did you come up with any reason for why I might be doing the study? [Queried] Whilst you were doing the task did you think of any reasons in your head for why I might be doing the study?

G-05:01 I guess it is, what you said from the email, saying engineers use of that so, actually I was wondering as well, as in, engineers use, how they understand email or how often they communicate using email.

C-05:32 That's fine. I was just asking as part of seeing the participant has done the study well is checking if they were aware of your hypothesis; if somebody is doing a study and they're aware of the hypothesis behind the experiment then that can do the task. That's why I was asking. The work itself is looking at how to improve engineers ability to interpret emails. So you say things like you didn't know about the project context or some of the domain terms like the technical terms, or you didn't know the details that all gets in the the way of your interpreting the documents without necessarily you realising it or in your case, you did realise it.

G-06:21 Yeah but if they are working on that thing, when they discuss they will of course know that...

C-06:29 Yes. But the problems is that engineers now, or engineering records, is that lots of it is, all you get is the emails and people come into the project, say 3 years after it started and they got told to... oh that is discussed in the emails, "don't ask me it is in the email" and they have to go and read what you've just read and ask the same sort of questions. that's the idea.

B.13. Volunteer H

This is a transcript of an interview of Volunteer H by Craig Loftus. The interview was conduction of 2010-08-04 it is 03:14 in length and was transcribed by Craig Loftus.

B.13.1. Speaker Key

C Craig Loftus

H Volunteer H

B.13.2. Transcript

C-00:00 So I hope that wasn't too arduous. I realise its not very much fun. Some of these questions aren't appropriate for PhD students but... you're doing a PhD now, what was your degree in? Your undergraduate or masters?

H-00:22 My undergraduate it was industrial engineering, system analyser, system analysing actually. My master is maintenance engineering and management and right now I'm doing mechanical engineering.

C-00:46 And did you do your previous degrees in Iran?

H-00:50 No I did my previous degrees in Sweden, its a joint programme between Iran and Sweden.

C-00:58 Okay. Through those courses did you get any familiarity with the hydraulics or power electronics that...

H-01:06 Not too much.

C-01:09 And have you had any experience in industry? Like placements or working?

H-01:12 Yeah, after I worked for industries for 7 years.

C-01:16 Okay. Which? Can you name some particular companies?

H-01:21 Yeah, 3 years I working for a factory that produces soap and shampoo, I was working on their IT systems. Like a system analyser. 4 years working for a big factory that producing heaters and coolers. I started from maintenance manager first then became vice-president of the factory.

C-01:56 So that was a purely managerial role?

H-01:58 Yeah exactly. The 2nd one was as a manager.

C-02:01 Okay. Now about the activity you've just done. How did you it? Did you find it difficult or relatively easy?

H-02:09 Its not difficult, but the thing is my English is not perfect, so I had some problems with understanding but yeah I understood. They are talking about changing the lubrication system, they want to improve the lubrication system where 1 pump so.

C-02:26 And do you think you answered all the questions to your satisfaction?

H-02:28 I answered all the questions but I don't know if it is right or wrong.

C-02:32 Oh, there is no right or wrong, its just whether you feel satisfied with the answers. Were there any particular questions that were difficult or you couldn't find the information to answer them?

H-02:44 No.

C-02:45 Okay. Can you... While you were doing the work did you make any suppositions or guesses about what the experiment is about?

H-02:57 In this one?...

C-03:00 No sorry, the actual...

H-03:01 Oh the actual?

C-03:04 Why am I doing this, do you think?

H-03:05 Ah, I don't know.

C-03:07 [Laughs] That's fine.

H-03:10 I don't know. Is it mechanical or is it not mechanical? Its different.

C-03:14 Its an information management project. The reason I asked that question is that if whilst you're doing the experiment you're guessing as to why I'm doing the experiment you'll be changing the way you answer the questions based on what you think I'm doing. So that's just a control question.

B.14. Volunteer I

This is a transcript of an interview of Volunteer I by Craig Loftus. The interview was conduction of 2010-08-04 it is 02:40 in length and was transcribed by Craig Loftus.

B.14.1. Speaker Key

C Craig Loftus

I Volunteer I

B.14.2. Transcript

C-00:00 Do you have any familiarity with the hydraulics or power electronics?

I-00:11 No.

C-00:12 That's fine. You did a placement in airbus didn't you?

I-00:15 Yes.

C-00:16 And that was a full year placement?

I-00:17 Yeah.

C-00:19 Well those are the background questions. You mentioned finding the task difficult, like lots of acronyms that you didn't understand and things?

I-00:30 Oh, it was lack of familiarity with ad trying to work out who's who and what they're trying to... what their view point is. It took a while to work that out. Not everyone had clear communication about which company they were from and what their role was from their emails. Where as the [unclear] was quite obvious and after a while I could piece together what was going on but it was a bit confusing to start with.

C-01:11 Okay. Were you satisfied, mainly, with the answers you gave? You indicated that question 5 wasn't...

I-01:21 Yeah, spot the difference was hard, I couldn't spot the difference. I just concentrated on the information at the top and didn't read the big paragraph. I didn't really get enough time to summarise the whole thread but that's also quite difficult because you've got different people coming in at different times, saying different things and it sort of progresses from one to another. I think anyway. So that was quite difficult. Work out who people were and what their companies were and what their roles were was a little easier because you could try and find the... if they'd put a proper signature down and then and how they referred to each other.

C-02:09 While you were doing the experiment were you thinking... or do you have any suppositions as to why I'm doing the research?

I-02:24 Yeah. I can't really remember, it was a while ago.

C-02:30 I don't mean remembering back from my seminar, I'm just asking if you're aware of the hypothesis behind the experiment?

I-02:39 I wasn't whilst I was doing it.

C-02:40 Okay. I'll take your word for it. Its just a control thing.

B.15. Volunteer J

This is a transcript of an interview of Volunteer J by Craig Loftus. The interview was conduction of 2010-08-04 it is 01:57 in length and was transcribed by Craig Loftus.

B.15.1. Speaker Key

C Craig Loftus

J Volunteer J

B.15.2. Transcript

C-00:00 Okay. So you're doing a PhD at the moment, I know that, what were your previous degrees and where were they?

J-00:16 I did a bachelors degree in Bath uni in mechanical engineering.

C-00:23 Okay, and did you a masters degree?

J-00:26 No.

C-00:28 Do you have any familiarity with the hydraulics or power electronics they were talking about?

J-00:31 [Laughs] No.

C-00:32 That's fine. Have you worked in industry? Like a placement or...

J-00:38 Yeah I did a 1 year placement.

C-00:40 Okay, and where was that? What kind of work?

J-00:44 Near Yeovil and its a manufacturing company.

C-00:51 and you worked as a design engineer?

J-00:55 Yeah, in the design department?

C-00:56 Okay. In terms of the task, how did you find it?

J-01:04 Its not my area, so I found it quite... very technical and a lot of people which are involved in this project and a lot of details and and some it isn't very clear.

C-01:31 Do you think you answered all the questions to your satisfaction? You were happy that you had enough information to answer the questions? Or were there any ones that were particularly difficult?

J-01:49 I don't know. I don't know whether I answered it right.

C-01:52 There is no right answer, it is just your interpretation so.

J-01:57 I think were was quite a lot of information there and maybe it would be better if it was structured in a more clear way. Because at the start I tried to figure out what are the different roles of those person and maybe you can structure it in a better way so it is clear internal, external, so if it is communication between internal and external email and if you talked to the customer outside you can have a separate email. Just as a thought.

B.16. Volunteer K

This is a transcript of an interview of Volunteer K by Craig Loftus. The interview was conduction of 2010-08-05 it is 06:11 in length and was transcribed by Craig Loftus.

B.16.1. Speaker Key

C Craig Loftus

K Volunteer K

B.16.2. Transcript

C-00:00 Can you tell me a little bit about your degree before you started your PhD?

K-00:09 Yeah, it was a degree in mechatronics in Leeds from 2002 to 2005.

C-00:19 So was that a masters degree?

K-00:21 I was on a masters programme but I cut it short and just finished with a bachelors.

C-00:26 And then did you do another masters before starting your PhD, or did ou just come straight...

K-00:28 No I did sort of dribs and drabs of other courses. I did a PGCE whilst teaching and then I did a few open university courses at masters level for engineering.

C-00:42 Okay. And have you worked in industry as a placement or... in engineering I mean.

K-00:48 No I worked... teaching engineering for apprentices, so teaching hands on and other stuff. And I've worked summer jobs in SMEs and smaller industry.

C-01:04 Do you have any familiarity with the hydraulics or power electronics that was talked about in the emails?

K-01:10 I worked self employed reconditioning dental pumps so I know a little bit about pumps [laughs] and a little bit about hydraulics and vane pumps and stuff but no I'm not hugely au fait with that subject.

C-01:30 Okay. How did you find the task, the questions?

K-01:37 I could have been a lot more involved with it, I think if you sort of look at the... I started mapping out who was being cc'd into which email to try and get an idea of which information was getting to who but I didn't finish doing that and I think the task could go quite deeply if you wanted. But in terms of just looking at the emails I found them quite confusing to be honest. I don't know whether that was intention or whether I'm just... [laughs]

C-02:08 Its not unexpected. Its not necessarily intentional, but its not unexpected. Its not a very clear email set. Where there any particular questions that you found difficult to answer.

K-02:20 Yes, the 2nd one, in terms... I think, yeah, the final state of the change. There wasn't any clarity or revision list or anything that could say someones opinion was more final than the others. If you know what I mean?

C-02:40 Yeah. And question 5, was that okay?

K-02:44 Question 5. I only partially finished that but... which one was it. The difference between the emails... yeah, I think Martin forwarded an email to the PowerCon team and then James pretty much did a few little tweaks and then passed it back on to BTP. But maybe I could have gone deeper into that question.

C-03:17 You asked what the point of this was. Do you have any ideas of what the point might be?

K-03:22 The effectiveness of email communication maybe, in design, or something along those lines.

C-03:34 I'm just asking to see if you're hypothesis aware. Okay. A sort of standard experimental control. [Start of waffle about reasons for experiment] [jump to interaction...]

C-04:51 It might just slow you down for example. How did you find it in terms of... were you haphazardly clicking on links or were you very focused on the ones you weren't sure of.

K-05:01 No, I was... to begin with I was clicking on a lot of them, just to be sure I wasn't... There were some quite simple ones on there where I did know what it was but I clicked on it anyway just to make sure. Like sea trials, see if that gave me a more involved description and then after that I used them a lot more sparingly. But certainly for acronyms...

C-05:32 Obviously for some of them you could give more information, you could say which sea trial it was they were referring to. I didn't go into that because the sort of thing we're targeting is whether just helping people with the terms they're unfamiliar with helps them integrate... helps them in their interpretation process. Rather than trying to give them more information, if that makes sense... Because as soon as you start giving them more information you're testing the information you're giving them rather than the intervention itself.

K-06:11 That's fair, yeah.

B.17. Volunteer L

This is a transcript of an interview of Volunteer L by Craig Loftus. The interview was conduction of 2010-08-05 it is 02:28 in length and was transcribed by Craig Loftus.

B.17.1. Speaker Key

C Craig Loftus

L Volunteer L

B.17.2. Transcript

C-00:00 So you're doing a PhD now in the AMPS group, the machine group. What were you previous degrees in?

L-00:12 Masters in mechanical engineering and bachelors in mechanical engineering.

C-00:18 Okay, and over that period did you do any placements or have you worked in industry?

L-00:23 Very short period.

C-00:27 Okay. And on anything relevant to the sort of hydraulics or power electronics discussed in here?

L-00:31 No.

C-00:32 So you didn't have any fore-knowledge?

L-00:35 No.

C-00:36 Okay. How did you find the task? Was it... did you find it annoying or frustrating, hard?

L-00:50 Its distracting for me, its difficult to see the relations between whats going on.

C-01:05 Okay. Do you think you answered all the questions to your satisfaction? There was enough information to answer them?

L-01:14 I think there were enough information but I didn't go through all the information.

C-01:26 Okay. With the links did you choose quite specifically links to click on or did you click on lots? Or did you find it distracting?

L-01:30 I did click on a few of them and and a few of them did help, but there was few.

C-01:36 Were there any questions in particular that were difficult or?... Questions in particular that were difficult.

L-01:46 I didn't answer question 2 and I didn't answer question 5, and question 5 I might could do something about question 2 but I couldn't do anything about question 5. And I'm not sure about the answers I gave to the others as well.

C-02:10 Well there aren't any right or wrong answers. do you have any idea of why I might be doing the work. During the experiment did you think of reasons?

L-02:28 If I want to relate the first task we did the 2nd task I can say its going to be something about... for me, how much I can get from a set of information in the form of emails in front of me and if I can get to the main point where there are lots of different things around.

B.18. Volunteer M

This is a transcript of an interview of Volunteer M by Craig Loftus. The interview was conduction of 2010-08-05 it is 02:11 in length and was transcribed by Craig Loftus.

B.18.1. Speaker Key

C Craig Loftus

M Volunteer M

B.18.2. Transcript

C-00:00 And over that period did you do any placements or have you worked in industry?

M-00:07 A very short period

C-00:08 Okay. On anything relevant to the sort of hydraulics or power electronics discussed in here?

M-00:16 No.

C-00:17 So you didn't have any foreknowledge?

M-00:18 No.

C-00:19 Okay. How did you find the task?

M-00:27 What do you mean, how?

C-00:29 Did you find it annoying, frustrating, hard?

M-00:39 Its distracting for me. Its difficult to see the relations of whats going on.

C-00:48 Okay. Do you think you answered all the questions to your satisfaction? There was enough information to answer them?

M-00:57 I think there were [sic] enough information but I didn't go through the information.

C-01:04 When with the links, did you choose quite specific links to click on or did you click on lots? What was your strategy?

M-01:11 I did click on a few of them and a few did help, those few.

C-01:23 Were there any questions in particular that were difficult? (Repeats question)

M-01:28 I didn't answer question 2 and I didn't answer question 5... and because question 5... I might could do something about questions 2 but I couldn't do anything about question 5. I'm not sure about the answers I gave to the others as well.

C-01:54 Well there aren't any right or wrong answers (Mumbling)

C-02:00 Do you have any ideas for why I might be doing the work? During the experiment did you think of reasons?

M-02:11 If I want to relate the first task with it, to the 2nd one I can... I can say its going to be something about... for me how much I can get from a set of information in the form of emails in front of me and if I can get to the main point where there are lots of different things around.

B.19. Volunteer O

This is a transcript of an interview of Volunteer O by Craig Loftus. The interview was conduction of 2011-07-15 it is 27:19 in length and was transcribed by Craig Loftus.

B.19.1. Speaker Key

C Craig Loftus

O Volunteer O

B.19.2. Transcript

C-00:00 So first some specifics I suppose. How long have you worked for [X]?

O-00:05 21 years.

C-00:06 21 years? And could you briefly describe the current and past roles

O-00:15 My current role is project director, so I am managing a number of major contracts and my previous roles have been in smaller projects, smaller contracts and when I started in the company I came in as a contracts officer looking at all the commercial legal aspects of the agreements of the project.

C-00:41 So like a warranty manager type role, or?

O-00:43 More on the legal side, looking at risk liabilities, consequences of delay and trying to sort out financial and legal documents

C-00:56 Do you have an education in hydraulics and power electronic, or would you say you are familiar with them?

O-01:03 I am familiar with them, my degree is mechanical engineering so...

C-01:12 Okay. Now about the task, how did you find the task?

O-01:17 I was trying to recall a lot of the circumstances at the time and I couldn't remember some of the key points, like what started it off. I remember there was a sea trial and problems at sea trial with oil flows and I can remember at the end fitting an additional pump or additional pumps to try and get the flow right

C-01:45 Well the first one describes, the first email describes that there was a sea trial and it was successful but they wanted to improve the situation. Is that under reporting? Is it actually a failure rather than a desired improvement?

O-02:03 Yeah, I think a desired improvement is an understatement, they had a serious contractual problem with KA who were not happy with the way the oil was supplied to the motors

C-02:15 I guess it is a classic way things don't get reported in the way that actually happens

O-02:22 Particularly when you're doing work with [X] culture, you see they are trying to be very polite

C-02:26 Yes, it is all about face isn't it?

O-02:28 They are trying to be very polite, to get your help and assistance

C-02:33 Interestingly, one of the reasons we are looking at email is that we expect there to be more of the dirty laundry if you like, or not dirty laundry, but more of the actually problems compared with the reports which are usually gloss over any negatives or any decisions that were not taken

C-02:55 Were there any questions that were particularly difficult to answer? You spent a lot of time on questions 5 I think?

O-03:01 Yeah, question 5, the discussion of differences... yeah I did not read that right and was looking at earlier emails at the beginning of the trail and the end and trying to look at the differences there rather than the last two, but once I got onto that I was a bit more clear on where you were going.

C-03:23 I have a question here that probably does not apply to you, do you trust the information in the email?

O-03:32 There was a lot of... very technical stuff that I trusted the numbers had been quite factual... yeah, in general I did. The trouble with BTP is that, or again, a [X] customer, is that you are very conscious they have a commercial position, so they are putting forward a proposal that is probably the most economic for them and maybe compromised too far for our system. Right on the bone of the oil flow, for example. Rather than "lets design this to be safe". They would not do that because they would have to buy another pump size up or something like that. You are always conscious that that is going on in the background.

C-04:24 So, sort of related to that, can I ask what you answered for question 5?

O-04:29 Five... there was some additional paragraphs at the end that were not really related to it, to do with control and training. Control was a little bit related. But in [X] reply it was factual to a point and there was some views he had got from KA that were more is thoughts and feels so that was getting a bit touchy feely and not so factual. My last response to the customer was trying to draw out the points as simply and succinct as I could.

C-05:07 That is what I was going for with that question. The idea is that it was testing your interpretation of the thread and for other people, your role in it which is the integrative role. The person trying to actually make sense of it all, dropping some points that FLAC had brought up that you did not think were relevant. So that is good.

C-05:38 Did you have an idea when you were going through the about why I might be doing this research and what my hypothesis might be?

O-05:45 No, I nearly asked you at the beginning actually.

C-05:52 I was deliberately trying not to tell you... at the beginning.

O-05:55 Yes. Well my guess is that you are looking at how problems not so much evolve, how you get a problem and how it is solved, and the processes that go through.

C-06:14 That's not what I am looking at... that is good. That means you were not hypothesis aware, so that is fine. What I am look at is email reuse, and helping people who perhaps are not familiar with the original project, or are but are looking at it after 4 years... helping them understand the original emails. So, to say if you were to come back now, this issue had been brought back up or a different one... and you having to go back and try to understand why you said what you said at the time. It is that sort of problem.

O-06:53 Okay, so...

C-06:56 Do you ever find yourself doing that... reusing emails?

O-06:59 Yeah, this particular one is very close to... we have had a problem on these ships, they have been in service for several years, to do with the oil system. It is not specifically these pumps but it is a good example of where a problem has now cropped up in service and the customer is complaining that the product is not working properly so you have to go right the way through the project to find out a little bit of the history... like this one. And try and establish how that design developed, how much BTP were influencing the design, and you know... is it because of that that we have the problems now or is it that our product is just not right. So there is a very real need to go back, and it is only...

C-07:50 So that's a combination of a design and a warranty issue?

O-07:57 Yeah, this particular one, they were claiming it was a warranty issue... no sorry, they were claiming we need to fit additional system in for oil to the bearings under warranty, and we were saying no, you should have provided the oil to this bearing at this rate and you are now asking us to fit something to supplement the oil flow... so was it there responsibility to push the oil flow up, or ours?

C-08:36 That's really interesting. Are there any other situations you can imagine where people reuse email?

O-08:43 Well if it goes into litigation, or something like that, a big argument, not just a warranty issue you cannot solve, but litigation then certainly people crawl through every email. When I was in the contract legal department you go right the way back through. Somebody has the view that this is the position, and we are taking the right line and you have to go back through a really demonstrate whether that is true or not. Quite often you find that there s a vital piece of information missing in this persons mind that changes the course completely. So there are some very good reasons for going back sometimes... I go through people on my team and they say we should not be paying for this because the specification says that, so you go back, you look at the specification, you look at what was tendered, you look at what was said, and try and prove it right or wrong.

C-09:43 Are there other uses in terms of people joining your team now? Trying to catch up with?

O-09:51 That is a good point, yeah.

C-09:50 Is that done? I am trying not to feed you answers and failing.

O-09:53 It is done. I have just this morning... this poor guy who has hurt his leg...

C-10:00 Oh, the cruciate ligament or hamstring?

O-10:04 Yeah... it was his Achilles tendon snapped. Not only did he need to get information on the projects he was running, but because I am leaving I needed to brief him... or moving to another part of the company. I need to brief him on the project, so I have given him a summary and now I am sending him some emails which sort of fill in some of the gaps. So that is the hand over from one to the other, the hand over to the service department you need to pull up the relevant emails that they need and the same when the job has just been signed, there is another hand over.

C-10:44 Oh, the tendering...

O-10:45 Tender to contract. So you... there is reading of information there. So each hand over: tender-contract, contract-service, new project manager...

C-10:58 I found an email from, I think it was, [X], when he was leaving as project manager and then I think the email was as curt as "I forwarded the new person" I cannot remember his name, the new guy, "all of my email"

O-11:16 [X]?

C-11:18 "I have forwarded [X] all of my emails, good luck!" [laughs]

O-11:23 He went to... he might have even gone to [X], coincidentally. You know we are being bought by [X]?

C-11:32 Yeah, I know.

O-11:34 That is very interesting.

C-11:38 How is that process going? Are you in due diligence at the moment?

O-11:40 I think it is well past that now. They are still going through a process of... you have got to finalise some documentation but I think the due diligence is finished we are now at the stage of... because there are so many different countries involved, each country has there own regulatory requirements for a purchase...

for example [X] that was done fairly quickly, very close to American ideology. The UK has now, the [X] have got some very specific rules...

C-12:14 The German labour laws are quite strict as well...

O-12:18 Yeah, so those union labour requirements, making sure the Americans are going to run the company in the right way before they sign off on it. But I think it is going to happen, I am sure. [X] are now in looking at how to sort out the finances. Not looking at the figures, but how to merge systems and make them work as one company.

C-12:46 I think [X] is going to have a few headaches in that regard as well... with the various information systems...

O-12:53 Yeah, I am sure it is going to be... whether they say... this is what you do.

C-12:58 I think quite looking forward to getting rid of the Google apps things.

O-13:03 Is he? [laughs]

C-13:05 He is a Lotus man.

O-13:07 Yeah, he definitely is. Well Lotus Notes, this tool which you saw.. that was great but it is now very quickly falling into disuse because the overhead of... for me, to take an email and put it into there via Google... I said to [X] "get me down to 2 or 3 clicks" and were are up, 10 and waiting for things to happen. It is just terrible.

C-13:42 I am trying to think of other uses... do you ever share, or do you ever have situations where external people are collaborating with you, not like in a customer-client relationship but more like a subcontractor relationship where they will be having to communicate with [X] employees quite directly.

O-14:06 We have a number of relationships with Universities... like you. But also doing design consultancy work and sometimes we pay companies to do design consultancy. Subcontractors will be given a specification and design to that, so... I do not think you are talking about

C-14:28 No it is more of a deeper collaboration, the idea... or the thing I am trying to get at is if you have problems with differences of vocabulary or... say if you are communicating with academic, they will have no idea what a brick is or... I can't remember any other [X] vocabulary... but [laughs]

O-14:53 [X] and things like that.

C-14:55 Or the [X] or whatever it is now, or whatever other acronyms.

O-15:00 Working with the [X] now in... they have bought the 2 rigs from us and now we are trying to give them training and support and things like that. I just find it amazing, they can write something down and we interpret it one way and it is so far off what they want. In emails, if you sit and you talk you get a much much better feeling...

C-15:30 Is that a language thing rather than, or a cultural thing?

O-15:35 I think... I suppose...

C-15:40 I know [X] have very different ways of ask questions and looking at problems... like the [X] have similar differences, or similar sized differences.

O-15:47 Yeah, and those 2 do not get on at all. The 2 approaches, and we sort of sit in the middle. [unclear] Even with the [X] I think most of it is language, if we sit... there are some very very bright [X] designing fantastic things but you down and you think he is thick he just does not understand you. And it isn't he has just not understood the words, so it comes across completely wrong and you have to check and double check to see if he has understood. And also you get people doing that [nodding, I think], which you think means he has understood but it just means "I have heard you". [laughs] Like the [X] when they go...

C-16:44 I was about to ask if you have a similar problem with the [X] is it? Or do you not work with them?

O-16:49 I do. Their English is usually pretty good... a good understanding of English. But in their mind set is different to ours. They will do exactly what it says on the paper where as here you would read what is on the paper with a bit more interpretation and you know what we are trying to get in terms of a solution and be looking at the solution rather than it says do that... we would say "it says do that, but he wants this" and you work out a way of doing...

C-17:26 [X] has mentioned similar... there is more hand holding required.

O-17:33 Yeah. And the [X] are very... they do not want all this detail in the middle, they know what they want there and just sort of rush towards that.

C-17:44 So the [X] you are describing, they are a customer?

O-17:47 A customer. If it is not a customer... we try to put these things more on a level of a partnership... we never quite get there because we are always the supplier. You need to be in that sort of relationship. [X] we are developing relationships, cooperating with exchanging information on some designs in order to get some more orders. There is that sort of cooperation going on.

C-18:21 Okay. If I [unclear]

C-19:35 Part of the work I am looking at is ways of helping people either remember or discover the context that original emails were written in, to try and help with this problem of understanding or reusing emails. One of the different techniques we have looked at is finding nouns or proper nouns, so names of, for example, systems within emails and then providing contextual information about them. So, for example, if you clicked on that, as an example you would get a description of what a sea trial is and perhaps in a more advanced system you would a PLM like reference to the sea trial document or you might get...

O-20:40 So this is aimed at helping overcome this different nomenclature and terminology and different cultures

C-20:52 Yes, but also say you are reading an email and you are obviously familiar the nomenclature and vocabulary but you might have forgotten where, lets find a good example... you might have forgotten where the drawings for the stand by pump are or you might have forgotten what that means in the context of this project. If a stand by pump is different another ship than it is on the [X] for example. A standby by pump is probably a bad example in that case, them you would click on that and it would give you the PLM document that referred to the pump within that document for example. I am wondering whether you

think, from your experience whether that kind of information, if it were added automatically, without cost, whether it would have value?

O-21:54 I certainly think these, DS and BPS and things like that...

C-22:00 So vocabulary terms

O-22:01 Yes, we quite often... nomenclature use, those abbreviations and things, acronyms, that is very difficult at the beginning and you get different acronyms for the same thing. Especially across different cultures that's tricky. We do it here as well, AIM, Automated something Marine and then IAS, ICMS, they actually are the same thing and I find we get problems with inconsistent use of these things across documents. For example in the contract you will see a word for pump, maybe it is a sea water pump, and then in the specification we have done, we call it a fire pump and then you see somewhere else in the training manual it is called an emergency pump...

C-23:13 But they are all the same!

O-23:15 They are all the same thing and that is extremely confusing for a [X] or a [X], he just cannot fathom out what we mean, especially if there is a difference between the contract and the drawing, those two have got to be consistent. If there is a way of either highlighting that we have used something out of context, that would be very useful I think. We've got a lot of problems with that.

C-23:44 Do you think that there would be any value in the, sort of, more explicit project tie-ins, in terms of things... that one is not a very good example, for some reason some things are not appearing... but say if... apparently there is a link there but it is not colouring it for some reason. Say the reduction gear driven pump that refers to a specific component or a specific set of components within the design, if rather than linking to a description it linked to a CAD model or that or some carefully structured document in your PLM, which I am sure exists. Or in a hypothetical world where all these documents actually exist, would it be useful to have those links in or is it something that an engineer would already know how to find very trivially anyway?

O-24:57 If it did it automatically it might be useful, but it strikes me that there are millions of places where that would occur and how would it automatically pick up what you want. It seems like it could be a massive overhead to do it. It is useful but not massively I would say. Nice to have...

C-25:17 Yeah, it is trying to get a balance between different things.

O-25:23 I would say if we had got our consistency of nomenclature across things right it would be far more important that perhaps trying to be able to link that to a...

C-25:37 It is not so much related to the nomenclature but would turning this around the other way be any use, where, the terms that have been identified automatically were used to categories the emails? So that you would go into your [X] folder and then there would be a folder for Lubrication System and it would give you all the emails about the Lubrication system without you having to categorise things in that way. Would that help with the way you use email or?... Or might it change it?

O-26:17 One of the things I like about Google is that you could put lubrication scheme in and it has got a very powerful machine for finding everything that... that

search facility I am finding extremely useful. You know, volumetric pumps, if I can remember the key word, back pressure bleed off, all of those things there you can now go very quickly and pick up every email with it in. What you can not do though is perhaps, you know, volumetric pumps, get all those, and then do another one and filter that bit. Or maybe you can but I have not seen it.

C-26:56 Also I suppose if you do not... if you can not remember that term that was used, say you can not remember the RG Driven pump in so and so section

O-27:09 And is it R dot G or R backslash, that would mess it up

C-27:19 Okay, well I think we will probably... [ends]

B.20. Volunteer P

This is a transcript of an interview of volunteer P by Craig Loftus. The interview was conduction of 2010-07-18 it is 14:19 in length and was transcribed by Craig Loftus.

B.20.1. Speaker Key

C Craig Loftus

P Voluneteer P

B.20.2. Transcript

C-00:00 I will just start with something basic biographically stuff. How long have you worked at PowerCon?

P-00:08 25 years... 26 years

C-00:11 Okay and could you briefly describe your current and past roles

P-00:16 Okay.

C-00:21 Sort of a broad summary rather than...

P-00:24 Okay, very broadly. Basically managing leading edge projects, projects on software and systems for engineering process that we have not done in the past. So it is typically applying new technologies to problems we have got with trying to produce new solutions.

C-00:45 Could you... would you say you are familiar with hydraulics and power electronics?

P-00:51 Not in detail, no. I know the basic principles but no I do not know the details.

C-00:59 And as more of an open question. How did you find the task?

P-01:07 Yeah, it was quite interesting. In the sense that broad process is very clear and it is also interesting the degree of delegation from [X]. Also not raising questions that are not actually being asked, sort of one of the things I am interested in. The drawing, I have to say, for me was not terribly meaningful. Without spending quite a lot of time reading it and understanding how it relates to the ship, the actual drawing is not that clear in my view. Yeah okay... it is an hydraulic system.

C-01:57 It is interesting. [X] could not understand it either and thought some bits were missing off it.

P-02:04 Yeah, I must admit it did not help.

C-02:07 Do you think you answered all the questions fully or to your satisfaction?

P-02:11 Yes, I think so. More or less. I mean in terms of who the key individuals are it is not entirely clear who the key individual in each BTP actually is, but that you either... they are an organisation with multiple communicants or one is in charge and the other happened to be involved, which is how I actually looked at it. Because they come from a variety of email addresses and different people I guess one just assumes the project manager is the key person.

C-02:42 Were there any particular questions, other than the one about key individuals that you found difficult to answer.

P-02:50 I did miss the significant point in the first email, which was the fact that the key part of the change was to separate the propulsion motor from the gear box lubrication. But I have to say that is partly because I could not read the diagram properly and it became clearer at the end that that was... you know... that was the development in principle. So it depends whether you look at is as though these were changes you want or whether you look at it from a higher level, which is not actually very clear. The high level over all requirement that was being changed and then the details. So it comes down to inferring what the higher level was a little bit. Although in practice when you realise what it is, it is fairly clear.

C-03:39 To what extent did you just trust the information in the emails on face value?

P-03:47 Well, given that I know nothing about this contract I basically trusted what people were saying. There is obviously some divergence of opinion in terms of the fine detail between BTP and FLAC in particular. I did not get the impression that PowerCon really minded one way or the other. So it just came down to, well if FLAC agree and BTP agree then that is fine. The information make sense but bearing in mind I am not a mechanical or electrical engineer. It makes sense to me, I understood what they were talking about, I understood what they were trying to achieve and the only outstanding question that was unresolved of significance is the filter specification. Which I can see is quite a critical point but that was not agreed on.

C-04:52 I will probably skip the remaining questions because they are more about asking whether you thought the idea was useful or has merit and discussing that but I think we have already had quite a lot of discussion on that. But, I suppose for the record, or whatever... do you think the changes in terms of providing contextual information assisted with your interpreting the topic? Did you click on any of them?

P-05:18 Right. 2 things... yes, I did click on some of the... just to check what I thought they were, so as confirmation yes that was useful. In terms of the actual mark-up I have to say the colours are quite significant and a bit distracting. Particularly, I will say, the blue and the black because I actually can not read that. Now I appreciate that is part of the experiment but... you know it is part of the actual set up but...

C-05:43 And obviously an interface, a real one, would not have this interface. A real system would not have these ghastly colours.

P-05:52 I think that is true, but I think that there is a more subtle point here in that highlighting does drawn your attention to specific points that necessarily means you attention is taken away from other points. If mark-up is not accurate you could actually miss important points that way. That does seem to be a little bit of an issue, it is a tricky problem I can see...

C-06:13 It is a very valid point and part of the reason is... I am not assuming that people with mark-up will do better than people without it. Because of that reason, does it introduce interference into the process of reading it? Every time you see a link you have to make a decision as to whether you are going to click on that link or not and just that action will slow you down. I think we have discussed other things before about whether the... sort of turning the system the other way around and utilising the concepts as categories rather than as links on the page would be a useful feature?

P-06:55 Yeah, I think it could be... [unclear]... I mean, most of this seems pretty straight forward. it is mostly organisation. There is discussion about exactly what they are trying to achieve, there are some issues to do with pressure drop. There is quite a lot of information in the emails.

C-08:05 When choosing a particular thread to choose, it was not necessarily a very clear cut choice. I tried to balance having a relatively few number of players with enough information to make the task juicy.

P-08:19 It would be interesting to know what [X] said about this actually because you know he is the project director, he is the one who is orchestrating this flow of information by sending out emails and by making sure, presumably, that key individuals know about the technical content.

C-08:40 He saw himself as a facilitator, a middle man, and when answering... I can not remember which question it is, the one about the key individuals, he tentatively put himself in a bottom fourth place... added himself on the bottom, said "I am not sure whether I count, because I was just... you know pulling the strings together, I did not actually contribute anything", is what his view was.

P-09:05 That is sort of interesting. But in fact, he does, because he contributes the control.

C-09:09 What did you answer to question 5, out of interest?

P-09:14 The answer to question 5? I mean as far as I could see, what [X] had done was leave out a point from [X] mail concerning whether there was any point in separating these things out...

C-09:30 That is exactly what I was looking for, I wanted people to identify [X] as the integrator or the facilitator and see that he had filtered the information from FLAC and made a business decision basically to say that they do not need to know about that.

P-09:45 What did [X] say to that?

C-09:46 That is what he wrote as the difference.

P-09:48 That is what he wrote? Oh okay, well that is more or less what I wrote.

C-09:52 Although he did not emphasise it as a business decision, it was more just simplifying...

P-09:57 No, it is that they do not need to know about this... yeah. I think that is very interesting, for me [X] is doing a really important role there because he is not giving hostages to fortune. He is basically telling the customer what he is asked, giving him factual information, but not actually opening ip the discussion.

C-10:16 That is exactly as he said. He was extracting the facts and presenting those and not extracting the opinion, originally from KA.

P-10:26 That really is a very interesting find. I actually think this was... from your experiment point of view quite an interesting choice and quite illuminating some of the facts.

C-10:38 Helpfully as well when going through this, I asked him about whether he reused emails in this sort of context and apparently just last week they had a warranty issue... not a warranty issue, a service issue come up on oil lubrication pumps in terms of their not performing in the way that they, BTP, think they should so they have actually gone through essentially the same process of...

P-11:00 And looked at, presumably, this same email?

C-11:06 No it was a different component. But the same... type of component if you like. But yeah, he said that it was timely. It is good for me in terms of justifying the choice of thread.

P-11:21 I mean, I will tell you... one of the things here I think, I can see that... I mean the problem with email is that it is a very... it is used for absolutely everything, scheduling and organisation and facts, data, actually the sequence is quite important and I did find I was having to refer to the date timestamp a bit to actually see who sent what when. And then the problem is of course, it is not clear because I am not sure what the actual date is showing is it showing local time or is it showing time sent. And if it is time sent, is it local time it was sent or universal time. I have to say notes is usually very good at that, it is generally very clear and you can actually tell form the email exactly what timezone it came from. Where as I don't think...

C-12:20 I think it is... [unclear]... I adjusted the date. There were all just UTC time. So it should be reflected in... if it is a silly time in the morning.

P-12:36 [unclear]

C-12:36 That was the only way that I could think to do it sensibly with Thunderbird.

P-12:39 No, that is a good idea.

C-12:45 But for me it was not so much the... it was just the sequence the emails that mattered. There were not, sort of, overlapping threads going on...

P-12:59 I think in this particular set, there did not seem to be, because there was only one key co-respondent. Really which was the key from FLAC, because... [unclear] [X] is the FLAC one but I thought David Brook made something here... [unclear]... I do wonder how useful a network diagram of the mail would be? Perhaps, I do not know. Because as a project man you would probably know it, but as someone looking in from the outside, you probably don't know it. If you had to pick it up as an outside project manager you might find it more tricky.

C-13:51 In terms of [X] comments, the other things he specified as being useful, unrelated to this, was the, I do not know if you remember, James produced some diagrams showing levels of different types of email activity with project phases and trying to look at identifying problems. [X] is still very interested in that concept, I do not think it is something James did much more work on.

P-14:19 No, I have to say, that it is difficult to know... What you and James produced early on was very interesting and I do think that had something quite significant potential merit in it. How that would be integrated into a mail system... I am very divided about mail I have a feeling it is with us... but people are not liking mail because it is so confused. You have got multiple threads of activity coming in concurrently and it is just interleaved in terms of email.

B.21. Volunteer Q

This is a transcript of an interview of Volunteer Q by Craig Loftus. The interview was conduction of 2010-07-19 it is 17:19 in length and was transcribed by Craig Loftus.

B.21.1. Speaker Key

C Craig Loftus

Q Volunteer Q

B.21.2. Transcript

C-00:00 First some quick specific questions. How long have you worked at PowerCon?

Q-00:07 I have been here for 23 years.

C-00:11 And could you briefly describe your current and past roles. Sort of, simply...

Q-00:18 My currently work in offshore service, I am the technical support manage in offshore service, which means I look after a team of engineers offering technical support to customers with operational systems installed on their vessels. That can include software upgrades, hardware changes, system... general system upgrades... training. Technical queries that customers have. Problems, breakdowns that sort of thing.

C-01:07 Is that just service to products and services that PowerCon has already supplied or do you provide generic service?

Q-01:17 Generally it is for our systems, yes. Very rarely do we get involved in other peoples systems. But from time to time we do. Before that I... I have sort of worked in service for probably 10-11 years and before that I was an applications engineer within the marine division, before that I worked in sales in the marine division and before that I worked as an applications engineer in the metals division.

C-02:03 And could you explain briefly what an application engineer does?

Q-02:07 An applications engineer is someone who takes technologies, systems, products and puts them all together to meet the requirements for a customers needs. So when he comes to us and says I need a... for example, dynamic positioning system then the applications engineer will need to look at what the interfaces

are to the customers equipment, what different systems he needs to meet his demands, network infrastructures, how many controllers, how many work stations that sort of thing.

C-02:56 Through your work would you describe yourself as familiar with hydraulics and power electronics?

Q-03:03 Erm, no.

C-03:04 And, now it is more, sort of, open questions. How did you find the task that I asked you to complete?

Q-03:13 Which one, or the...

C-03:17 Just the second set, the questions.

Q-03:19 It was okay. I found... even after reading the questions, that I was reading the emails... I even thought to myself at one point... I am reading these emails in too much detail to need to know the answers to the questions, so from then on I sort of skip over the minor details that I didn't really need to know. So, that part was probably the biggest waste of time, and I knew I was wasting time after I had started doing that. But generally I thought it was not too difficult to answer.

C-04:08 Do you feel you answered all the questions satisfactorily, or...

Q-04:11 I think so.

C-04:14 I mean just to your own satisfaction, I don't mean anything else. Were there any that were particularly difficult to answer or that you spent more time on relative to the others?

Q-04:26 No. I don't think... they were... All 5 questions were I guess similar... required similar amounts of thought to put down. I guess one thing, with describing the 3 key individuals within the thread... which I found a little bit confusing... not confusing... picking the 3rd guy was maybe... because it was kicked off by one guy in BTP and then it seemed to be taken over by another one, so.

C-05:08 That's okay. You weren't involved in this project?

Q-05:10 No I wasn't involved at all.

C-05:11 Did you find that you were implicitly trusting the information in the emails or would you say you were doing a lot of interpretation or trying to work out the motives for example, behind certain emails?

Q-05:28 It was just a factual... that is all I was looking at

C-05:33 Could you suggest... whilst doing the exercise were you coming up with any ideas for why I might be doing this work?

Q-05:43 No. Well, it came to the back of my mind why is this relevant to... following this you're going to be asking me some questions about maybe emails in general... I was briefed that it is to do with emails and things but I can't see where it is leading.

C-06:12 That's fine. It is a standard thing in these experiments is to test or hypothesis awareness. Some people will change the way they answer the questions depending on whether they think you are doing something and sometimes they can be

completely wrong about what they think you are doing. What I am looking at is reuse of emails, so a problem like I have set you... somebody who is not familiar with the project or wrote those emails 5 yrs ago, going back and trying to understand why a particular decision was taken or why a particular event occurred. For things like warranty issues or building a familiarity with the project, for example. Are those kinds of use cases something that you have ever find yourself using emails or, or others?

Q-07:04 We do use emails for that sort of use. It is difficult sometimes to try and find the relevant information afterwards. Emails get stored in all sorts of different places. There is a database that we in service tend to use quite a lot, so we can hopefully try to find something that...

C-07:44 That is the service correspondence database?

Q-07:46 It is the correspondence database, yeah. Yeah, how... sometimes some item will come up and we will think, have we actioned that or I seem to remember that happening a while ago... and we try and find the data and it is not always easy to find it. That is one problem and trying to track through threads of emails that... perhaps didn't follow on immediately from... with a gap of some months in between maybe a different thread was started on the same subject elsewhere and it is difficult to piece it all together. We do... need to do that from time to time.

C-08:38 And do you find yourself reading emails to find people to go and talk to about a particular subject for example? So if you're involved in servicing a particular project... I understand that you'll often hand the projects records from sort of handed over to service.

Q-08:59 Yes.

C-09:02 Do you use the records directly, or is it more you just go and talk to the person immediately?

Q-09:08 I guess usually we're lazy and we... you know... as soon as something comes up that we can't immediately put our finger on the answer we will just go and talk to the project engineer involved. If they are not available then you know we might do something digging around and see who is actually responsible for what and maybe finding something related to this subject in particular, but generally we will go straight to the people who we think will be able to give us an answer.

C-09:40 It is probably usually the fastest way to do it. This is looking at cases where the person isn't available... it is a 30 year old project for example. They wouldn't have had emails at the moment, they would have other documentation... Part of the reasons behind the experiment is looking at helping people understand the emails by adding the authors context or the authors knowledge to the emails. Things like the definitions of terms to... that is why there are the hyperlinks added in. Do you think that is something that would be useful to you personally or does your experience already have the sort of information it was providing?

Q-10:29 Not entirely. There are a few times I used them for clarification, generally I guess I knew most of the terms in there. Certainly I used it to quickly lookup FLAC. I have never heard of FLAC before but... I saw the initials used. I saw LO system and I was clicking on that link that it was actually lube oil and not

something else that I didn't actually understand or whatever. That is not to say everybody in the Company would though. If that is easy to do then I think that would be useful.

C-11:22 Did you find that it is the vocabulary problem a noticeable one with, say, new starters? You mentioned other people...

Q-11:32 Yes. There are... I don't think it is just new starters either because a lot of people in the company will have quite a narrow view of what is going on. They'll focus on this particular system, so anything out to the side they wouldn't even have a clue what it means.

C-11:53 So is that also between different domains as well? Marine versus renewables?

Q-11:57 Absolutely, yeah. So, there is going to be lots of people in the company who have no idea about particular terms that are used within a different department or even just a different area within the same department.

C-12:14 You mentioned a couple of questions ago, when you were talking about finding emails and constructing... stitching together the threads if you like... would you see a use if the sort of terms that have been picked out here were turned the other way around and used as categories for emails. So you would be able to browse by different occurrences of a system term or would you usually use search for that type of functionality?

Q-12:49 Well I guess we sometimes do search for emails with those terms in already, so doesn't that functionality already exist?

C-13:09 Search does, but what I am suggesting is that there are certain tools now that can identify concepts within emails so say they could identify not just the explicit mention of a term but the notion of a particular component in something, referred to in 5 or 6 different ways. So you could search for using any of those names and it would return the whole set.

Q-13:38 That would certainly be a big help to us. I mean probably service is the department that would benefit from this more than any other because we have to deal with subjects that perhaps we don't know anything and all these different jobs with different subjects that have been passed to us we have got no idea what has gone on in the past. So there is a potential benefit there certainly, if it is implemented in a way that is going to be useful to us... easy to understand, easy to use.

C-14:19 Requiring no effort, yes. Yes, those are definitely issues. I had an interview with [X] yesterday, I think he works in service as well?

Q-14:31 Does he? I wasn't aware that he does.

C-14:38 I might be mis-remembering.

Q-14:40 I know [X] as a tools developer, so, internal tools such as [X] and [X]. He has moved into a different building so he could be doing something completely different now.

C-15:02 There was a discussion anyway, about the role of people in translating internal speak, PowerCon speak into... for customers. Is that something you would describe yourself as doing within service? Or do the customers already speak the language, if you like, the terminology?

Q-15:23 I think there are people within service who will reply to customers using terms that are specifically PowerCon and I always try... well I never do that. I always... it is not relevant to a customer to describe it in PowerCon terms. It doesn't aid understanding by anyone really, so that I think is just down to each individual who is composing the emails. But it is something that exists and I would like to see fewer people making use of specific terms that won't mean anything to customers.

C-16:25 And are they usually things like product names or components names or do they include sort of technical domain specific type vocabulary? Like the LO system for example?

Q-16:38 No. I don't mean that really. I mean LO system for someone in PowerCon is the same as an LO system for someone in a [X] or [X]. It is just PowerCon terminology such as, modification documentation, instead of using that we will say [X]. Customer is going to get that word and think what on earth is he talking about?

C-17:11 So it is perhaps more related to the process, the work that is going on rather than the details or it...

Q-17:18 Yes, yes.

C-17:19 That's interesting. Okay, I think that is it for my questions.

B.22. Volunteer R

This is a transcript of an interview of Volunteer R by Craig Loftus. The interview was conduction of 2011-07-19 it is 09:55 in length and was transcribed by Craig Loftus.

B.22.1. Speaker Key

C Craig Loftus

R Volunteer R

B.22.2. Transcript

C-00:00 So if I could ask some specifics to begin with? How long have you worked for PowerCon?

R-00:07 Long than it has existed. [laughs]

C-00:12 [X]

R-00:17 I have recently had my 35 year service award.

C-00:22 With that combine...

R-00:23 Going back to the original [X], but half of that wasn't at this site.

C-00:29 Okay, but you spent 35 years within the culture... a similar group of people.

R-00:36 Yes.

C-00:37 Could you briefly summarise, thematically, your roles, and at what time. Very broad strokes.

R-00:44 These days primarily I am a manage of software engineers, in earlier times I was more of a software engineer. But originally I was in electrical design. I actually joined the company as a commissioning engineer.

C-01:04 So, when you say electrical design...

R-01:09 That is light electrical. Where as this Company is now mainly heavy electrical.

C-01:10 Did you go through a phase of doing analogue design; software in circuits, type stuff? I don't really know what the proper phrasing is.

R-01:19 I think the electrical stuff I did was mainly instrumentation. Interface between the computer and the real world.

C-01:35 So would you describe yourself as being familiar or not with the hydraulics and power electronics?

R-01:42 No. Hydraulics only in the sense that drives a car has heard what it is about. Power electronics, very vague.

C-01:56 My other questions are more, sort of, open. How did you find the task? The email task. Rather than the memory task.

R-02:02 Yes. How did I find it? My biggest problem with it was the detail on the hydraulics and pumps and things. Which was something that I couldn't relate to and therefore I couldn't remember.

C-02:22 You said you think you answered all the questions to your satisfaction?

R-02:29 Maybe not to your satisfaction, no.

C-02:30 No, no. To your satisfaction. There aren't any right answers, obviously. Were there any questions in particular that were difficult to answer, or you took more time over.

R-02:43 I guess the last one, with the difference was... I suppose the first one was more difficult because you had to try and prcis all that information into a concise set of words and you had to read through quite a lot to actually work out what was going on.

C-03:07 And you weren't involved with the project?

R-03:10 Not directly, no.

C-03:11 Were you implicitly trusting the information, like a factual level or did you find yourself thinking about their motives, the way people were saying certain things?

R-03:27 I didn't have any doubts about it.

C-03:30 Okay. Whilst you were doing did you have any ideas about why I might be doing the study... any thoughts about my motivations?

R-03:41 You're doing a PhD aren't you? [muffled] Your motivation I think is trying to... would appear to be would be to try and work out whether people can assimilate information from reading things.

C-03:59 Okay.

R-04:02 I didn't know that before hand. When I came in here I had no idea what this was about.

C-04:04 I ask that because people change they answers they give based on their own ideas of what I want. So it is just to try and see what you thought I wanted. You're broadly correct. That I am looking at helping interpret emails that they are not familiar with. So looking at reusing email because a lot of what information might previously have been in reports is now solely in emails and largely inaccessible.

R-04:42 And largely incomprehensible.

C-04:44 Do you find through your work that you ever reuse email in a long term sense. Going back to a previous project, perhaps a couple of years ago? Trying to figure out why a decision was made or copy a design for a piece of software.

R-04:57 No. That doesn't... as yet we're not putting software design into emails. We're not putting software design anywhere [laughs]. So I don't think it quite works that way. I do occasionally try to look back through emails to say, why did we decide that? But it is more a questions of functionality than design.

C-05:27 Oh yeah. I meant on a more abstract level than detail.

R-05:30 But it is very very infrequent.

C-05:33 I understand you're a senior manager, or would I say director level?

R-05:41 Oh no. Middle I guess is the word.

C-05:45 Okay. But you manage a group of people. When new people are introduced to that team, do they rely on email at all to bring themselves up to speed?

R-05:53 No.

C-05:55 Okay. It is all face to face and meetings? Or they slowly figure out...

R-06:00 Slowly probably. Yes mostly from meetings and discussions. An example, because we're less project based we have less history to what we are doing. It is here and we want to change it, how it got to here is not worried about.

C-06:22 So when you say you're not project based, how does...

R-06:28 We're in the development department, so we develop products. So yeah... we have a failing in that we don't necessarily always specify the requirements, if we had they probably wouldn't have been in emails.

muffled

C-07:17 Part of what... one of the ideas that we have been looking at is helping people understand email by introducing the original context in which emails were written, so the understanding the author had when they wrote it. I terms of things like vocabulary definitions or what a particular component refers to. So some people in this experiment have been getting emails marked up in a very mickey mouse sense, with descriptions about, for example... so they might get some description about what that term means. Or what a particular company's role is, and there are ways we might implement that in a real life scenario. Obviously these are all hand made, but there are various summarisation and indexing systems that can approach that. Would you see any advantage in that kind of contextual assistance? I realise you haven't actually said reuse emails, so it is maybe a difficult question to answer.

R-08:33 It is interesting... if for my own I wouldn't need it and I wouldn't expect to. Where it is introduced for someone taking over at a later date or someone new to a service type arrangement then that sort of thing could be quite useful. Because you know... "[X]" I had absolutely no idea what it meant... I just ignored it. Bearings is the only thing that I twigged. So, yeah it could be quite useful in certain circumstances. But I do ask myself, if you can't understand enough of it without that, are you the right person to be doing it?

C-09:22 Unfortunately that is not necessarily always the option.

R-09:25 Yes, that is true.

C-09:27 Part of the idea with this, and thinking in the very long term as well, in 20 years time when there is an entirely different set of people working here. Whether that will become a problem in the future. Hopefully not. There have been cases, or anecdotes I've heard in PowerCon of 30 year old projects being revived and trying to figure out how it works.

R-09:55 Yes, I don't know about 30 years old, but certainly refurbishment on vessels were we... "how did that hang together?"

C. Emails

Email 1

Subject 1632-Reduction Gear and Propulsion Motor L.O. System

To "Oliver Perkins" <oliver.perkins@powercon.com>, "Henry Jones" <henry.jones@powercon.

From "James Timpson" <james.timpson@powercon.com>

Message-Id <BCF49860E66E390D8025729D0035F1D8@powercon.com>

Date Mon, 12 Mar 2007 12:20:00 +0000

References <email_v_1@btp.com>

Content-Type text/html; charset=UTF-8

Content-Transfer-Encoding 7bit

Oliver and Henry

Would you please review and advise me of any concerns that you may have. Obviously the requirements on BTP are no less than we state on our drawings and my reply will be careful to ensure that they achieve these.

Would you please respond tomorrow - with your thoughts in line with BTP deadline below.

Regards James Timpson Project Director

— See email dated: Mon, 12 Mar 2007 10:15:30 +0000—

Email 2

From "Tom Wilson" <tom.wilson@btp.com>

To "James Timpson" <james.timpson@powercon.com>

Cc "Charles Hake" <charles.hake@btp.com>

Subject Re: 1632-Reduction Gear and Propulsion Motor L.O. System

Message-Id <email10435@btp.com>

Date Tue, 13 Mar 2007 05:24:36 +0000

In-Reply-To <46338F86D639845D8025729C005FA189@powercon.com>

Content-Type text/html; charset=UTF-8

Content-Transfer-Encoding 7bit

Dear James Timpson

Thank you very much for your cooperation during sea trial. We were deeply impressed for you to support the issues with quick response and can complete sea trial without major issues. Thanks again. As you imagine, now it is time to move the commissioning of cargo system and we need your continuous support with keen attention.

Regarding the subject, it is necessary to implement the software for operation of the additional "2 propulsion motor L.O booster pump". We have generally discussed with EPS engineer onboard and be informed as follows.

- Prolulsion motor L.O booster pump shall be automatically started prior to propulsion motor start
- Automatic sequential starting shall be carried out when blackout recovery.
- ST-BY pump shall be changed over automatically in case of low pressure and no voltage of the running pump. (we will provide one discharge line.)

If further comment, please let us know.

the sofeware related to the above FDS shall be inplememeted in EPS program.

In this regards, please inform the possible correction date of software onboard and cost. Your urgent review and confirmation would be appreciated.

Regards Tom Wilson / BTP

Email 3

Subject AW: 1632-Reduction Gear and Propulsion Motor L.O. System

From "Martin Smith" <martin.smith@flac.co.uk>

To "James Timpson" <james.timpson@powercon.com>, "Oliver Perkins" <oliver.perkins@pow
"Fabien Quessy" <fabian.quessy@powercon.com>

Cc "James Cooper" <james.cooper@flac.co.uk>

Message-Id <email10463@flac.co.uk>

Date Wed, 14 Mar 2007 17:25:15 +0000

In-Reply-To <1178ADEB6EC4D42B8025729E004AD2DF@powercon.com>

Content-Type text/html; charset=UTF-8

Content-Transfer-Encoding 7bit

Dear Mr. Timpson,

Thank you keeping us informed. The coloured answers from BTP unfortunately were lost during the transmission I think - I have restored them in heavy letters as far I could identify the BTP comments.

Please allow some small comments on BTP answers:

- no comment
- We were not aware the gravity tank shall be filled by the booster pumps as well, and this demand is explaining the extended flow supply capacity.

- No answer/explanation given regarding the requirements for valves 258V and 259V - just a statement BTP will let these valves in the supply lines. The settings of these valves changed from 2.0 to 2.8 bar, but might be readjusted during next sea trial.
- No comment
- "Agreed by R/G maker)", not by FLAC Frankfurt, the bearing maker. Nevertheless, FLAC Frankfurt has no problem with the proposed solution - as mentioned in our yesterday message. But isn't longer a "smart system".

From another message we have understood KA is interested in having a fully separated motor bearings (tank, pump, and all the required stuff for pre-heating, oil cooling, filtering, sensoring and control).

The actual viscosity grade ISO VG 150, because the R/G ist demanding this viscosity. For the faster running motor this oil is quite thick, but the oil as maintained for/by the R/G can be used for the motor bearings. Making the motor circuit independent from R/G we should come back to a lubricant in type and viscosity grade optimised for the motor bearings. However, we can't state such "separation" would help for more reliabilty and safety. In our opinion the reliability of a system goes down with the number of devices required for sensoring, control and requirements for maitenance. In this regard a seperate oil unit not only isn't smart, it is more expensive, needs more controls - and the whole drives reliabilty is on lower level than for an integrated solution. But if the ship owner wants to have it separated ...

best regards

Martin Smith (general manager dept. HS)

mailto: martin.smith@flac.co.uk

Email 4

From "Charles Hake" <charles.hake@btp.com>

To "Martin Smith" <martin.smith@flac.co.uk>, "James Timpson" <james.timpson@powercon

Subject 1632-Reduction Gear and Propulsion Motor L.O. System

Message-Id <email_v_1@btp.com>

Date Mon, 12 Mar 2007 10:15:30 +0000

Content-Type text/html; charset=UTF-8

Content-Transfer-Encoding 7bit

Dear Sirs,

Thanks to your kind cooperation, hull No. 1632 from Mar. 9 to Mar 12 successfully.

And ship owner and BTP think that the test records are so much successful.

However, refer to L.O. system as follows as shown on attached drawing:

Attachment: 1632-RG-Motor-LO-System-070312.pdf

- Add two (2) sets of additional lubricating.

- These pumps suck oil directly from FLAC gear box L.O. sump tank instead of downstream of the R/G L.O. pumps.
- In doing this, BTP does not install separate L.O. cooler for propulsion motor lubricating. The reasons are;
  - The L.O. temperature in R/G L.O. sump tank was kept continuously at 50 Deg. C during sea trial.
  - The normal supplied L.O. temperature was 55 Deg. C at bearing inlet and 61 Deg. C at bearing outlet during sea trial.
  - The alarm setting point of motor bearing is 85 Deg. C
- By doing this, BTP can provide steady L.O flow as well as L.O. pressure as much as propulsion motor required. And this system will work as a separate Powercon motor operation.

Please review attached BTP's new proposal and confirm.

Considering lead time for additional pump purchasing and piping modification work before the Gas trial, we would like to ask you to confirm by Opening of office in Japan Mar. 14(Wed.), 2007. Your kind/prompt attention to this would be much appreciated.

Charles Hake/Project Manager

Project Planning Dept, Ship Building Div.

Email 5

Subject 1632-Reduction Gear and Propulsion Motor L.O. System

From "Tom Wilson" <tom.wilson@btp.com>

To "James Timpson" <james.timpson@powercon.com>

Cc "Fabian Quessy" <fabian.quessy@powercon.com>, "Charles Hake" <charles.hake@btp.com

Date Wed, 14 Mar 2007 08:32:10 +0000

Message-Id <email_v_5@btp.com>

In-Reply-To <4197915876A13E6F8025729D006A95E2@powercon.com>

Content-Type text/html; charset=UTF-8

Content-Transfer-Encoding 7bit

Dear Mr James Timpson

Thanks for your good cooperation so far. For youe question on below e-mail, please be informed as answered by blue letter.

I.) BTP proposed includes motor bearing lubrication As we understand it the electrical driven booster pumps are meant for permanent operation, providing constant lubrication oil flow for the motor bearings.

Yes

The two pumps will operate alternatively.

Yes

If this understanding is correct the observed critical oil flow conditions for the lower prop. speed (=lower motor speed) due to small pressure from R/G driven pump would be eliminated completely.

Yes

Even the influence from the oil filter in the oil pipe to the motor bearings not should be a problem.

Yes

In our view if the booster pumps are volumetric pumps (e.g. gear type; flow rate strictly related to pump rotation speed) they should generate the pressure to generate the required flow rate through the existing flow restrictions.

Yes

For such supply condition a relieve valve ought to be provided to limit the max. pressure for personnel and equipment protection.

Yes

II.) The rated flow for each motor is about 32 l/min

It was 33L/min(DE 23L/min + NDE 10L/min)

– 64 l/min(66L/min) for both motors in total. 5.4 $m\hat{3}$/h = 90 l/min appears to us too much. A bleeding-off valve should be considered by BTP but in addition BTP should consider this arrangement with care because a bleeding-off valve can make flow adjustment for each bearing more difficult. FLAC would prefer a pump capacity just a little bit above the rated flow - e.g. 70 l/min in total.

5.4M3/H(90L/min) to be sized from 66L/min(for R/G L.O. gravity tank), and confirmed by FLAC. 5.4M3/H to be kept as it is.

III.) If BTP use the booster pump design then the following components in the modified lubrication scheme may not in our opinion be required but we are not certain of there function:

- #294V. Purpose and effect on motor supply conditions not clear. Probably it is providing regulation of the pressure in the supply line to motor bearings (for higher booster pressure the valve will motor lubrication circuit - like a pressure relieve valve).
- Yes
- 289V. Purpose and effect not known.
- To be prepared to quite clear the problems of air bubble comming from the R/G L.O. sump tank, even through air bubble may be happened again at cold starting later
- Valves pressure limiting valve; set: 2 bar) may no longer be required if pumps are providing a constant flow about regardless of the oil temperatures. The back pressure from flow resistances for cool oil may run higher than 2 bar and in consequence the flow rate through flow switch. The oil not passing through probably is escaping through booster pump bypass (with valve 294V).
- Valve 294V to be for maintaining 4.5 bar, and to be kept as it is. Valve 258V & 259V to be also kept as it is.

- The only advantage FLAC see from these valves is that the flow adjustment for each motor can be done independent from adjustment of the other motors flow. If this is the purpose of these valves we are in doubt whether a small pressure like 2 bar is a robust setting.
- Setting value for valve(258V, 259V) to be 2.8 bar in view of 20L/min at 2.5bar during the previous Gas trial.

IV.) Oil filters for each motor supply line. We would not expect a problem because the pressure regulating valves 258V (259V) is getting the pressure response signal from downstream the filter, so the filter resistance deviations do not become effective on bearings flow settings as long as the max. filter difference pressure PLUS set-pressure is below about 4.5 bar.

Yes

V.) FLAC does not say, the proposed solution "booster pump" is the required solution - and wishes to make it clear that they have made a number of proposals on how the flow resistances in the original R/G-pump low pressure operation close to 400/420 rpm.

BTP proposal to be already discussed and agreed by FLAC, as per the enclosed.

Using booster pumps will require additional sensors for emergency handling.

The pump to be controlled

- pump start by propulsion motor start signal
- Pump auto. change-over by discharge side
- Pump stop by manual

For a constant flow from booster pump no modifications are required at the flow control devices for each bearing: set point 80

Yes

In addition to this we anticipate that you will want us to modify the HMI to include these additional pumps and some trip and analogue signal for pressure. We need to have a discussion with our colleges at Madrid to see if they are able to do the control and sent the appropriate signals over the network to the HMI. We would appreciate BTP's confirmation on the method and system that they expect to use for control. Once we have this discussion we will be able to provide a price for this as a variation.

Please check our e-mail dispatched by Tom Wilson on Mar. 13th and also we discussed today with Mr. Fabian Quessy and Steven Taylor. However, analogue signal for pressure is not necessary.

Your prompt confirmation to above would be appreciated.. Best regards

Tom Wilson/General Manager Ship Outfitting Design Dep't

Email 6

Subject Re: 1632-Reduction Gear and Propulsion Motor L.O. System

To <charles.hake@btp.com>

From "James Timpson" <james.timpson@powercon.com>

Message-Id <46338F86D639845D8025729C005FA189@powercon.com>

In-Reply-To <email_v_1@btp.com>

Date Mon, 12 Mar 2007 14:10:00 +0000

Content-Type text/html; charset=UTF-8

Content-Transfer-Encoding 7bit

Charles,

Thank you for your email. I am delighted that Powercon has been able to be a part of this sucessfull sea trials.

We will provide any comments that we have on your proposed improvements to the lubrication system tomorrow evening our time. We anticipate that this solution will deliver the interface requirements as set out in out motor drawing and therefor will be an acceptable solution.

Regards James Timpson Project Director

Email 7

Subject AW: 1632-Reduction Gear and Propulsion Motor L.O. System

From "Martin Smith" <martin.smith@flac.co.uk>

To "James Timpson" <james.timpson@powercon.com>, "Oliver Perkins" <oliver.perkins@pow
"Timothy Rivers" <timothy.rivers@powercon.com>

Cc "James Cooper" <james.cooper@flac.co.uk>

Date Tue, 13 Mar 2007 16:24:17 +0000

Content-Type text/html; charset=UTF-8

Content-Transfer-Encoding 7bit

Dear James, Oliver & Tim,

Referring to message below we would like to give our comments.

- BTP proposed elt. Booster Pump for Motor bearing lubrication As we understand the electrical driven booster pumps are meant for permanent operation, providing constant lubrication oil flow for the motor bearings. The two pumps operated alternatively. If this understanding is correct the observed critical oil flow conditions for the lower R/G driven pump would be eleminated completely. Even the influence from oil filter in the oil pipe to motor bearings not should be a problem: In our opinion the booster pumps are gear type; flow rate strictly related to pump rotation speed) and will generate as much pressure as required to push the flow rate through the existing flow resistances. For such supply condition a relieve valve is required for limiting the max. pressure for human and component protection purpose.
- The rated flow for each motor is about 32 l/min – 64 l/min for both motors in total. 5.4 $m\hat{3}$/h = 90 l/min appears to us too much. A bleeding-off valve would be required. We are not sure if this would be a good arrangement because a bleeding-off valve makes flow adjustment per bearing more difficult, we think.

FLAC would prefer a pump capacity just a little bit above the rated flow - e.g. 70 l/min in total.

- Accepting supply by volumetric discharging booster pumps the following components in the modified lubrication scheme in our opinion are not longer useful or their function not understood:
  - #294V. Purpose and effect on motor supply conditions not clear. Probably it is regulating the pressure in the supply line to motor bearings (for higher booster pressure the valve will motor lubrication circuit - like a pressure relieve valve).
  - 289V. Purpose and effect not known.
  - Valves pressure limiting valve; set: 2 bar) not longer required if pumps are providing a constant flow about regardless of the oil temperatures. The back pressure from flow resistances for cool oil may run higher than 2 bar and in consequence the flow rate through flow switch. The oil not passing through probably is escaping through booster pump bypass (with valve 294V). The only advantage from these valves we can see is, the flow adjustment for each motor can be done independent from adjustment of the other motors flow. If this is the purpose of these valves we are in doubt whether a small pressure like 2 bar is a robust setting.
- Oil filters for each motor supply line. No problem because the pressure regulating valves 258V (259V) getting the pressure response signal from downstream the filter, so the filter resistance deviations do not become effective on bearings flow settings as long as the max. filter difference pressure PLUS set-pressure is below about 4.5 bar.
- FLAC does not say, the proposed solution "booster pump" is the required solution - we have made a number of proposals how the flow resistances in the original oil supply chain can be reduced, to earn sufficient flow rates even for R/G-pump low pressure operation close to 400/420 rpm (e.g. removing the additional oil filters). Using booster pumps will require additional sensors for emergency handling. For a constant flow from booster pump no modifications are required at the flow control devices for each bearing: set point 80 operation speeeds.

Best regards

Martin Smith (general manager dept. HS)

mailto: martin.smith@flac.co.uk

— See email dated: Mon, 12 Mar 2007 10:15:30 +0000 —

Email 8

Subject Lub oil system (Mechanical and Control) - LNG for BTP - Ref: /RBTP 932

From "James Timpson" <james.timpson@powercon.com>

To "Tom Wilson" <tom.wilson@btp.com>

Message-Id <8F630C3B991E8C7F8025729F003749B9powercon.com>

Date Thu, 15 Mar 2007 10:03:53 +0000

Content-Type text/html; charset=UTF-8

Content-Transfer-Encoding 7bit

References <email_v_5@btp.com>, <email10435@btp.com>, <email10463@flac.co.uk>

Dear Tom,

Thank you for your call this morning, it certainly helps to talk to have a clear picture of the priorities. Clearly you need a quick reply on the mechanical part and we provide this below. For the control part we need to have more detailed discussion when Spain which I believe is tomorrow.

LUB OIL SYSTEM for the motor.

subsubsectionMechanical part

We have discussed the comments in BTP 's email dated 14 March 07 a copy of the relevant part is below. Most points are answered by BTP with a yes which is good but just to close out the issues we have the following confirmation to add.

- No comment
- We were not aware the gravity tank is being filled by the booster pumps as well, and this explains the flow rate that BTP have selected for the pumps.
- Whilst BTP have not answered or explained the requirements for valves 258V and 259V - just a statement that they will be included in the supply lines. Additionally we understand that the settings of these valves that are changed from 2.0 to 2.8 bar might be adjusted during the next trials.
- No comment
- We understand that "Agreed by FLAC Berlin (FLAC Frankfurt, the bearing maker. Whilst BTP revised design would appear to meet the criteria stated for the motor bearing requirements it does not appear to be such a "Smart" design (Cost effective and simple).

subsubsectionControl part

Your email dated 13 March 07 (below) refers to the control of the pumps in this new arrangement. I understand that the discussion the Steven and Fabian had with BTP agreed the manner in which this control is being done in the motor control system and that this will be similar to the way the jacking is controlled. We will provide a quotation for the costs of this change when we have the fuller details of the change and how it will effect the HMI.

subsubectionTraining

The return of the vaporiser tests and the old fieldstations will enable us to put together a training system that could be sent to KA's without interrupting commissioning on board. It might also help in doing the changes BTP require to the vaporiser and gassing up sequences if our software design engineers are on site in Japan. We are now looking at how we can do these modifications when Nick will be on site. We confirm that we purchased his ticket and he is travelling on Sunday unless BTP advise us otherwise.

Best Regards

James Timpson Project Director Marine & Offshore Division

Powercon Ltd

Email 9

From "James Timpson" <james.timpson@powercon.com>

To "Timothy Rivers" <timothy.rivers@powercon.com>

Subject 1632-Reduction Gear and Propulsion Motor L.O. System

Date Tue, 13 Mar 2007 13:17:23 +0000

Message-Id <email_v_2@powercon.com>

Content-Type text/html; charset=UTF-8

Content-Transfer-Encoding 7bit

Tim

Following may call earlier with Oliver out today and Henry unable to help I would appreciate any comments that you or FLAC can offer today.

Thank you.

Regards James Timpson Project Director

Email 10

Subject Re: 1632-Reduction Gear and Propulsion Motor L.O. System

To "Charles Hake" <charles.hake@btp.com>

From "James Timpson" <james.timpson@powercon.com>

Cc "Fabian Quessy" <fabian.quessy@powercon.com>, "Steve Taylor" <steven.taylor@powerco

Message-Id <4197915876A13E6F8025729D006A95E2@powercon.com>

In-Reply-To <email_v_1@btp.com>

Date Tue, 13 Mar 2007 17:40:00 +0000

Content-Type text/html; charset=UTF-8

Content-Transfer-Encoding 7bit

Dear Charles Hake,

Further to your email below. From a mechanical and piping point of view the system would appear to achieve the design criteria that we require at our bearing interface. Referring to your points below we offer the following comments:-

- BTP proposed includes booster pumps for motor bearing lubrication As we understand it the electrical driven booster pumps are meant for permanent operation, providing constant lubrication oil flow for the motor bearings. The two pumps will operate alternatively. If this understanding is correct the observed critical oil flow conditions for the lower R/G driven pump would be eliminated completely. Even the influence from the oil filter in the oil pipe to the motor bearings not should be a problem. In our view if the booster pumps are volumetric pumps (e.g. gear type; flow rate strictly related to pump rotation speed) they should generate the pressure to generate the required flow rate through the existing relieve valve ought to be provided to limit the max. pressure for personnel and equipment protection.

- The rated flow for each motor is about 32 l/min – 64 l/min for both motors in total. 5.4 m$\hat{3}$/h = 90 l/min appears to us too much. A bleeding-off valve should be considered by BTP but in addition BTP should consider this arrangement with care because a bleeding-off valve can make flow adjustment for each bearing more difficult. FLAC would prefer a pump capacity just a little bit above the rated flow - e.g. 70 l/min in total.
- If BTP use the booster pump design then the following components in the modified lubrication scheme may not in our opinion be required but we are not certain of there function:
  - #294V. Purpose and effect on motor supply conditions not clear. Probably it is providing regulation of the pressure in the supply line to motor bearings (for higher booster pressure the valve will motor lubrication circuit - like a pressure relieve valve).
  - 289V. Purpose and effect not known.
  - Valves pressure limiting valve; set: 2 bar) may no longer be required if pumps are providing a constant flow about regardless of the oil temperatures. The back pressure from flow resistances for cool oil may run higher than 2 bar and in consequence the flow rate through bearings may fall below the limit defined by the setting of flow switch. The oil not passing through probably is escaping through booster pump bypass (with valve 294V). The only advantage FLAC see from these valves is that the flow adjustment for each motor can be done independent from adjustment of the other motors flow. If this is the purpose of these valves we are in doubt whether a small pressure like 2 bar is a robust setting.
- Oil filters for each motor supply line. We would not expect a problem because the pressure regulating valves 258V (259V) is getting the pressure response signal from downstream the filter, so the filter resistance deviations do not become effective on bearings flow settings as long as the max. filter difference pressure PLUS set-pressure is below about 4.5 bar.
- FLAC does not say, the proposed solution “booster pump” is the required solution - and wishes to make it clear that they have made a number of proposals on how the flow resistances in the original oil supply chain can be reduced, to earn sufficient flow rates even for R/G-pump low pressure operation close to 400/420 rpm.

Using booster pumps will require additional sensors for emergency handling. For a constant flow from booster pump no modifications are required at the flow control devices for each bearing: set point 80 motor operation speeds.

In addition to this we anticipate that you will want us to modify the HMI to include these additional pumps and some trip and analogue signal for pressure. We need to have a discussion with our colleges at Madrid to see if they are able to do the control and sent the appropriate signals over the network to the HMI. We would appreciate BTP’s confirmation on the method and system that they expect to use for control. Once we have this discussion we will be able to provide a price for this as a variation.

I hope that the above response is what BTP were expecting and enable the design to be finalised.

Best Regards James Timpson Project Director

Email 11

Subject Re: 1632-Reduction Gear and Propulsion Motor L.O. System

To "James Timpson" <james.timpson@powercon.com>

From "Oliver Perkins" <oliver.perkinsp@powercon.com>

In-Reply-To <BCF49860E66E390D8025729D0035F1D8@powercon.com>

Content-Type text/html; charset=UTF-8

Content-Transfer-Encoding 7bit

Date Mon, 12 Mar 2007 17:40:00 +0000

James

Seems if BTP have capitulated and supplied an oil system that will work!

Regards Oliver

Email 12

Subject 1632-Reduction Gear and Propulsion Motor L.O. System

From "James Timpson" <james.timpson@powercon.com>

To "Steven Taylor" <steven.taylor@powercon.com>, "Craig Little" <craig.little@powercon.co

Cc "Timothy Rivers" <timothy.rivers@powercon.com>, "Oliver Perkins" <oliver.perkins@pow
"Henry Jones" <henry.jones@powercon.com>

Message-Id <1178ADEB6EC4D42B8025729E004AD2DF@powercon.com>

Date Wed, 14 Mar 2007 10:23:47 +0000

References <email_v_5@btp.com>

Content-Type text/html; charset=UTF-8

Content-Transfer-Encoding 7bit

Gents,

Please find attached the latest reply from Lub oil system for the motors. Their answers are in bold text to my reply last night.

Re item V below I can only assume that this has come from the gearbox part of FLAC.

Would Steven please advise the results of the discussion with Tom Wilson with respect to control aspects that we may have to impliment in software/HMI.

– See email dated: Wed, 14 Mar 2007 08:32:10 +0000 –

Regards James Timpson Project Director

Email 13

From "Tom Wilson" <tom.wilson@btp.com>

To "James Timpson" <james.timpson@powercon.com>

Cc "Fabian Quessy" <fabian.quessy@powercon.com>, "Tom Wilson" <tom.wilson@btp.com> "Charles Hake" <charles.hake@btp.com>

Subject Fw: Fw: Lub oil system (Mechanical and Control) - LNG for BTP - Ref: /RBTP 932

Date Fri, 16 Mar 2007 09:19:11 +0000

Content-Type text/html; charset=UTF-8

Content-Transfer-Encoding 7bit

Dear Mr James Timpson

Thanks for your good cooperation so far. For your question on below e-mail, please be informed as answered by blue letter.

———————————————————————- Dear Tom Wilson,

Thank you for your call this morning, it certainly helps to talk to have a clear picture of the priorities. Clearly you need a quick reply on the mechanical part and we provide this below. For the control part we need to have more detailed discussion when Spain which I believe is tomorrow.

LUB OIL SYSTEM for the motor.

subsubsectionMechanical part

We have discussed the comments in BTP's email dated 14 March 07 a copy of the relevant part is below. Most points are answered by BTP with a yes which is good but just to close out the issues we have the following confirmation to add.

I.) No comment

II.) We were not aware the gravity tank is being filled by the booster pumps as well, and this explains the flow rate that BTP have selected for the pumps.

Yes

III.) Whilst BTP have not answered or explained the requirements for valves 258V and 259V - just a statement that they will be included in the supply lines. Additionally we understand that the settings of these valves that are changed from 2.0 to 2.8 bar might be adjusted during the next trials.

Yes. These valve may adjusted during next trial.

IV.) No comment

V.) We understand that "Agreed by FLAC" means "agreed by R/G maker)", not by FLAC Frankfurt, the bearing maker. Whilst BTP revised design would appear to meet the criteria stated for the motor bearing requirements it does not appear to be such a "Smart" design (Cost effective and simple).

- Please confirm what is the meaning of smart design. According to your drawing & design, if we provide 2.5bar at propulsion motor inlet side, the enough flow rate to be flowed to bearing part. However, Powercon well noticed during sea trial, even we maintained 2.5bar at just inlet side of propulsion motor side, the flowrate does not meet the required Q'ty.

  When we have the required flow Q'ty(23l/min on NDE), the inlet pressure should be more than 2.8 bar. This means the pressure drop on propulsion motor bearing side is bigger than you said. That is the reason why we can not but adding a separated additional supply pump system for solving propulsion motor problem. Please confirm what your opinion for smart design at this moment is.

- According to your strong recommendation, we have to provide 25 micron filter on propulsion motor side and generator side.

  However, this made the system more difficult. Normarlly engine maker or other machinery maker recommend 40-50micron and 25 micron is too fine, so this filter should be cleaned at every day and cause much complain from owner side.

  Please confirm the detail back-ground to select such kind of fine filter and also reconsider to use 40-50 micron.

subsubectionControl part

Your email dated 13 March 07 (below) refers to the control of the pumps in this new arrangement. I understand that the discussion the Steven and Fabian had with BTP agreed the manner in which this control is being done in the motor control system and that this will be similar to the way the jacking is controlled. We will provide a quotation for the costs of this change when we have the fuller details of the change and how it will effect the HMI.

To be separately discussed later.

Email 14

Date Tue, 13 Mar 2007 13:17:23 +0000

From "Timothy Rivers" <timothy.rivers@powercon.com>

To "James Timpson" <james.timpson@powercon.com>

Cc "Oliver Perkins" <oliver.perkins@powercon.com>, James Cooper <james.cooper@flac.co.ul

Subject Re: 1632-Reduction Gear and Propulsion Motor L.O. System

In-Reply-To <email_v_2@powercon.com>

Message-Id <email_v_3@powercon.com>

Content-Type text/html; charset=UTF-8

Content-Transfer-Encoding 7bit

James

I have not seen the original schematic. The one you sent shows no connection between the gearbox driven pump and our bearings so I assume the new electric pumps are replacing completely the original system where electric pumps run when the gearbox is running slowly and the gearbox pumps take over at higher speeds?

The quoted $5.4m^3/hr \times 4.5bar$ will meet the requirements of the bearings on the two motors. I assume the two pumps are individually rated for these figures and that one is main and one standby.

FLAC have commented regarding items that look like 25 micron filters. These have appeared immediately before the oil pipework split to the DE/NDE bearings for each motor. They are concerned that as these become dirty they will increase the pressure drop. What precautions are being taken to ensure the pressure does not drop to dangerous levels (1.4 bar). FLAC were of the opinion that the oil was already filtered to suitable levels before this re-design.

Regards Timothy Rivers

D. Working Memory Span responses

See tables D.2, D.3 and D.4 for the volunteers responses to the Working Memory Test (§ 10.2.2) conducted as part of the experimental intervention (Chapter 10). The responses were provided verbally during the test and transcribed by Craig Loftus.

The responses under the Words column are the volunteers response when asked to recall the stimulae for each set and the responses under the Checks column are the responses to the equations given during the stimulae presentation. The letters T and F correspond to True and False responses respectively. The rows a to h correspond to the increasingly demanding sets of equation stimulus pairs. The rows for sets not attempted by a volunteer are omitted.

The underlined responses are those the volunteers answered incorrectly.

	Words					**Checks**				
	1	2	3	4	5	1	2	3	4	5
a	bid	swept				F	T			
b	bib	scalp				T	F			
c	melt	dot	bud			F	T	T		
d	bed	hand	kin			F	F	T		
e	cub	add	red	gram		T	F	T	F	
f	scrub	nib	land	cod		F	F	T	T	
g	drift	cot	ebb	cab	let	T	F	F	T	T
h	rip	block	clump	bump	hop	F	T	T	F	F

Table D.1.: The correct responses to the Working Memory Span test.

	Words					Checks				
A	1	2	3	4	5	1	2	3	4	5
a	bid	swept				F	T			
b	bib	scalp				T	F			
c		swept	bud			F	T	T		
d	bed	hand	kin			F	F	T		
e	cub	res	gram			T	F	T	F	
f	scrub	cod				F	F	T	T	
C	1	2	3	4	5	1	2	3	4	5
a	bid	swept				F	T			
b	bib	scalp				T	F			
c	swept	bud				F	T	T		
d	bed		kin			F	F	T		
D	1	2	3	4	5	1	2	3	4	5
a	bid	swept				F	T			
b	bib	scalp				T	F			
c	melt	dot	bud			F	T	T		
d	bed	hand	kin			F	F	T		
e	cub	add	red	gran		T	F	T	F	
f	scrub	nib	land	cod		F	F	T	T	
g	drought	cot	scrub	nib		T	T	F	T	T
h	rip	block				F	T	T	F	F
E	1	2	3	4	5	1	2	3	4	5
a	bid	swept				F	T			
b	bid	scalpt				T	F			
c	melt	dot	bud			F	F	T		
d	bed		kin			F	F	T		
e	gram	cup				T	F	T	F	

Table D.2.: Working Memory Span responses for volunteers A to E.

	Words					Checks				
F	1	2	3	4	5	1	2	3	4	5
a	bid	swept				F	T			
b	bib	scalp				T	F			
c	melt					F	T	T		
d	bed	hand	kin			F	F	T		
e	cub		red	bud		T	F	T	F	
f	scrub	nib	lost	cod		F	F	T	T	
G	1	2	3	4	5	1	2	3	4	5
a	bid	swept				F	T			
b	bib	scalp				T	F			
c	melt	dot	bud			F	T	T		
d	bad	hand	kin			F	F	T		
e	cub		red			T	F	T	F	
f	scrub	pour	cod			F	F	T	T	
H	1	2	3	4	5	1	2	3	4	5
a	bid	swept				F	T			
b	bib	scalp				T	F			
c	melt		bud			F	T	T		
d	bed	kin	hand			F	F	T		
e	cob	hat	red			T	F	T	F	
f		nib	hand			F	F	T	T	
I	1	2	3	4	5	1	2	3	4	5
a	bid	swept				F	T			
b	bib	scalp				T	F			
c	melt	dot				F	T	T		
d	bed	hand	kin			F		T		
e	cub	red	gran	hand		T	F	T	F	
f	scrub	nib	land	cod		F	F	T	T	
g	drift	cot	cab			T	F	F	T	T
h	hop	rip	block			F	T	T	F	F
J	1	2	3	4	5	1	2	3	4	5
a	bid	swept				F	T			
b	bib	scalp				F	F			
c						F	T	F		
d	bed	kin				F	F	T		
K	1	2	3	4	5	1	2	3	4	5
a	bid	swept				F	T			
b	bib	scalp				T	F			
c						F	T	T		
d	bed	hand	kin			F	F	T		
e	cub	add	red	gran		T	F	T	F	
f	scrub	nib	land	cod		F	F	T	T	
g	drift	cot	ebb	cap	left	T	F	F	T	T

Table D.3.: Working Memory Span responses for volunteers F to K.

	Words					Checks				
L	1	2	3	4	5	1	2	3	4	5
a	bid	swept				F	T			
b	bib	scalp				T	F			
c						F	T	T		
d	bed					F	F	T		
N	1	2	3	4	5	1	2	3	4	5
a	bid	swept				F	T			
b	bib	scalp				T	F			
c		scalpt	bud			F	T	T		
d	bed	house	kin			F	F	T		
O	1	2	3	4	5	1	2	3	4	5
a	bid	swept				F	T			
b		scalp				T	F			
c	melt	dot	bud			F	T	T		
d		scalp	kin			F	F	T		
P	1	2	3	4	5	1	2	3	4	5
a	bid	swept				F	T			
b		scalp				T	F			
c			bud			F	T	T		
Q	1	2	3	4	5	1	2	3	4	5
a	bid					F	T			
b	bib	scalp				T	F			
c		dot	bud			F	T	T		
d	bed	hand	kin			F		T		
e	cub	add	red			T	F	T	F	
f	scrub	nib	land	cod		F	F	T	T	
g	drift	cot	ebb	cab	let	T	F	F	T	T
h	rip	block	clump	bump	hop	F	T	T	F	F
R	1	2	3	4	5	1	2	3	4	5
a	bid	swept				F	T			
b	bib	scalp				T	F			
c						F	T	T		
d	bed	halt	kin			F	F	F		

Table D.4.: Working Memory Span responses for volunteers L to R.

E. Object descriptions

The following object names and descriptions were provided to participants as part of the experiment described in Chapter 10. The name of the object given below corresponds with that within the text of the emails provided to the participants. Object names and text within square paraentheses separated by a long dash (—) indicate an anonomysation substitution occured.

BTP The principle manufacturer of the Liquid Natural Gas (LNG) tankers (ships) that are the final product of the project.

sea trial The test phase of watercraft. It is part of the test and validation phase of the construction of the ship and takes place on open water.

hull No. 1632 The identifier for ship 1632.

ship owner The organisation for whom the ships are being built.

Reduction Gear and Propulsion Motor L.O. System A collection of components and control procedures that provide lubricating oil to the reduction gearbox and the propulsion motor bearings.

L.O. system A collection of components and control procedures that provide lubricating oil.

L.O. pumps Pumps for providing pressurised lubricating oil.

propulsion motor Electric motors providing the power to move the vessel.

lubricating The process, or technique used to reduce friction between two surfaces, by interposing a substance which acts to carry the load between the surfaces

FLAC gear box L.O. sump tank A tank collecting lubricating oil that once it has passed through the reduction gearbox supplied by FLAC.

R/G L.O. pumps Pumps for providing pressurised lubricating oil to the reduction gearbox.

L.O. cooler Cools the lubricating oil before it is used again.

R/G L.O. sump tank A tank collecting lubricating oil that once it has passed through the reduction gearbox.

bearing inlet The entry for lubricating oil into the bearing.

bearing outlet The exit for lubricating oil from the bearing.

motor bearing The lateral constraints at both ends of the motor shaft.

FLAC R/G FLAC provide to the project a reduction gearbox that transfers power from the propulsion motors to a single shaft propeller.

PowerCon motor PowerCon provide the electric motors providing the power to move the ship.

Gas trial Part of the test and validation phase of the construction of the ship. Tests the functioning of all of the gas handling systems on the ship.

PowerCon PowerCon provide the propulsion motors and control systems to the project.

lubrication system A collection of components and control procedures that provide lubricating oil.

oil system A collection of components and control procedures that provide lubricating oil.

EPS Electric Propulsion System

FDS Functional Design Specification

L.O booster pump Pumps for providing pressurised lubricating oil.

booster pumps Pumps for providing pressurised lubricating oil.

ST-BY Stand by

pressure switch A pump switch that is activated by a pressure signal, based on pre-established conditions for activation.

blackout recovery The process of the ships systems recovering after a sustained loss of electrical power.

cargo system A collection of components and control procedures for the load, unload and managing of the cargo of the ship.

discharge line The pipe that is downstream of the pump.

FLAC Supply the Reduction Gear subsystem and propulsion motor bearings for the project. Two subsidiaries of the Company are involved with the project.

Oliver Oliver Perkins is an engineering manager working on the project within PowerCon.

gearbox driven pump Pumps that are power by a take-off from the reduction gearbox.

gearbox pumps Pumps for providing pressurised lubricating oil to the reduction gearbox.

R/G driven pump Pumps that are power by a take-off from the reduction gearbox.

R/G-pump Pumps for providing pressurised lubricating oil to the reduction gearbox.

DE/NDE bearings Differentiates between the two bearings in the propulsion motors; the Drive End and Non-Drive End bearings.

HMI Human Machine Interface

mimics A virtual (software) representation of a component within the system. The representation allows for characteristics of the component to be monitored and altered without direct manipulation of mechanical controls.

Henry Henry Jones, an engineer working on the lubrication oil system.

gearbox A reduction gearbox that transfers power from the propulsion motors to a single shaft propeller.

R/G A reduction gearbox that transfers power from the propulsion motors to a single shaft propeller.

oil pipework split a fork in the oil pipe that divides the oil supply in two.

motor Electric motors providing the power to move the vessel.

bearings The lateral constraints at both ends of the motor shaft.

bearing interface The boundary of responsibilities in the oil supply system to the bearings i.e. the oil inlets/outlets of the bearing

oil filter A mechanical restriction of the oil flow that removes particles from the oil

volumetric pumps Cause fluid to move by isolating a volume of oil from a supply pipe and then forcing the volume into a discharge pipe.

gear type A pump that uses 2 rotating meshed gears in a tight casing.

flow restrictions Features within the system that cause a loss in the power transmitted.

relieve valve A type of valve used to limit the pressure in a system. Pressure is relieved by allowing oil to escape from the system.

bleeding-off valve A valve for removing small quantities of oil.

lubrication scheme A collection of components and control procedures that provide lubricating oil.

Lub oil system A collection of components and control procedures that provide lubricating oil.

oil supply unit A collection of components and control procedures that provide lubricating oil.

oil unit A collection of components and control procedures that provide lubricating oil.

oil supply chain A collection of upstream pipes and pumps that provide oil to a given component.

motor circuit A collection of upstream pipes and pumps that provide oil to the motor.

motor lubrication circuit A collection of upstream pipes and pumps that provide lubricating oil to the motor.

Bypass line A fork in the oil circuit that occurs before a particular feature and reconnects after the feature; allowing for fluid to pass through while adjustments or repairs are made on the feature.

booster pump bypass A fork in the oil circuit that occurs before the booster pumps and reconnects after them

supply line The pipe that supplies oil to a particular feature.

bleed off Removing small quantities of oil from the system.

pressure relieve valve A type of valve used to limit the pressure in a system. Pressure is relieved by allowing oil to escape from the system.

pressure limiting valve A type of valve used to limit the pressure in a system. Pressure is relieved by allowing oil to escape from the system.

FLAC Berlin The division of FLACresponsible for the manufacturing of reduction gearboxes

FLAC Hannover The division of FLAC responsible for the manufacturing of bearings

back pressure The resistance to a moving fluid due to obstructions or tight bends in its container.

flow switch A component that monitors flow rate and sends a signal to another device.

set-pressure The pressure at which a valve opens or an alarm is triggered.

discharge side The side of the component that lubricating oil is discharged from.

KA The organisation for whom the ships are being built.

viscosity grade A measure of the level of resistance of the oil to shear forces

gravity tank An oil container that supplies non-pumped oil, i.e., pressure is provided by gravity and the mass of fluid.

R/G L.O. gravity tank An oil container that supplies non-pumped lubricating oil to the Reduction Gearbox, i.e., pressure is provided by gravity and the mass of fluid.

instrumentation A collection of instruments and their application for observing, measuring and controlling variables.

alarms Signals indicating the occurrence of some undesirable event

trip Signal indicating a critical event requiring that the associated system is shut down.

energizing Providing electricity and/or hydraulic pressure to a system, i.e., turning it on.

pre-heating Process of heating components before operation to minimise negative thermal expansion effects.

motor control system A collection of procedures for monitoring and adjusting the state of the propulsion motors.

jacking Is the process of using auxiliary equipment to keeping the shaft turning when the propulsion motors are not in use, e.g., in port.

IAS Integrated Automation System

cubicles A container for electrical systems.

vaporiser A mechanical component for regulating the flow of vaporised LNG.

fieldstations A generic term for an cubicle installed on site

Venting Chamber A chamber or pipe exposed to the atmosphere to allow for gas collecting in the hydraulic system to escape.

Fabien The Power and Propulsion project manager for PowerCon working in Spain.

Steven The lead Power and Propulsion engineer for PowerCon working in Spain.

#294V A valve within the circuit

289V A valve within the circuit

258V A valve within the oil supply circuit

259V A valve within the oil supply circuit

F. Intervention Answers

F.1. Correct answer

Q1

- Sea trials shows need to improve performance
- Change the L.O. system for the Reduction Gear and PM (?)
- Proposed changes reviewd by supplier
- Proposed changes confirmed by customer
- Supplier not convinced by changes

Q2

- Mechanical change agreed
- Settings of pressure values agreed
- Automation changes to be discussed
- Filter grade to be discussed further with view to reducing spec

Q3

[X] PowerCon Project Director

[X] BTP Project Manager

[X] FLAC specialist

Q4

BTP Shipyard, design and build

FLAC Bearings specialist/supplier

PowerCon Motor automation supplier

Q5

- The email from [X] left out points raised by [X]
- [X] advised on the benefits of splitting the motor bearing lubrication from the gearbox lubrication.
- Combining the 2 resulted in a compromised design.

F.2. Volunteer A

Q1

After sea trials, the email thread is a discussion between BTP, Powercon (Motorbox) and FLAC (gearbox) to develop the existing solution by adding two extra pumps to the motor lubricating system; and changing the control system accordingly. The emails summarise any problems or cautions (and proposed solutions) by those involved.

Q2

- Two Booster Pumps added
  - electrically driven
  - permanently operated (alternatively)
  - 25 micron filters attached (proposed)
    - filters have no effect on performance but may prove problematic with daily cleansing
    - may switch to 40-50 micron
  - pumps also fill the gravity tank
- pressure limiting valves are kept, but setting values will be altered and finalised in the next set of sea trials according to the flow rate.

Q3

James Timpson Project Director (member of PowerCon) main Powercon contract who then delegates accordingly. Proposes solutions that meet motor specifications and control system issues.

Tom Wilson Main Liason with clients, representing the customer, BTP. Answers all the queries or notified problems to Powercon & FLAC

Martin Smith FLAC representative. Proposing constraints for bearing design.

Q4

BTP Customer. Ship builders. Implements proposed solution and performs the sea trials.

FLAC Reduction Gear designers

Powercon Propulsion motor specialists - also in charge of the motor control system and and necessary alterations.

FLAC and Powercon are working toghether to produce a functioning lubricating oil sustem for the motor set-up.

Q5

James Timpson identifies the same final issues as Martin Smith although he furthers it by noting the control system issues and how these will need further time/work. (Powercon's responsibility). Martin Smith brings up an extra note on oil type and the con's of using a separate oil unit.

F.3. Volunteer C

Q1

This email thread outlines the discussion between companies working on the development of a bettter Reduction gear and propulsion motor L.O system. The discussion takes place between BTP, FLAC and powercon. Addition of two sets of L.O pumps and propulsion motor with suitable pressue levels and filters was agreed upon by the designers and manufacturer.

Q2

The final changes introduced were the use of booster pumps. The pressure level in the inlet side was made greater than 2.8 bar. The filter size of 25 microns was changed to 40-50 (which is recommended). These changes can be re-adjusted after the sea-triall. fully separated oil supply unit for the motor bearings was adopted. The two pumps will operate simultaneously. Relieve valve was a suitable compromise for limiting the pressure.

Q3

James Timpson is the project director of powercon. He is basically involved in improving the Reduction Gear propulsion moto L.O system of the hull no.1632 for the KA. This is done with the cooperation of BTP.

Tom Wilson of the BTP is the General Manager (Ship Outfitting Design dept). His role is to confirm the design suggestions made to him by the other companies.

Martin Smith is general manager (HS dept.) of FLAC. His role in this email thread is to clear the queries put forward by the powercon designers.

Q4

FLAC - Responsible for the manufacturing of reduction gear boxes. Lubricating system used has to meet the standard of the gear box.

BTP - Manufacturers of liquid natural gas tankers. This company carried out the sea trial of the hull no. 1632

Powercon - Is a design oriented company that looks forward into the practical problems involved in the proposal of BTP with consulation of FLAC.

Q5

In the final email from Martin Smith, he has summarised the comments made by BTP. Has has sent it to the powercon team.

The final email from James Timpson is detailed analysis and conculsions of the BTP proposal. He includes all the details that FLAC put forward and has sent it to the BTP - General Manager.

F.4. Volunteer D

Q1

Charles Hale has feedback from sea trial of a newly designed ship, which he sends to J.T.. J.T. asks help from O.P and MJ.

T.W asks for more solutions to software T.R asks JT about motor gearboxes and filters for redesign M.S offers comments and solutions on problems proposed by J.T T.W gives answers to questions from MJ MS comments on changes proposed JT replies to TW on mechanical, control and training TW replies to JT with comments

Q2

Booster pumps introduced Changes to pump capacities with bleeding off valve Oil filters for each motor supply line 25 micron filter on propulsion motorside and generator side

Q3

J.T. project director T.W. works for BTP gives solutions to software and answers questions from JT O.P. works for JT, pretty useless

Q4

Powercon - do propulsion motors and control systems BTP - want finished product - principle manufacturer employing powercon and FLAC FLAC - reduction gear and propulsion motors

Q5

TW prodives answers to comments proposed by JT

F.5. Volunteer E

Q1

BTP did the trial runs on a ship and wanted to improved the reduction gear provided by FLAC and the propulsion motor system provided by powercon. BTP is trying to improve the system even though the trials were success full. The thread is basically a discussion on the technical aspects of the system.

Q2

A 25 micron filter on propulsion motor

size and [x]

Q3

Tom Wilson * Employee of BTP * Co-ordinating the project * Look below the [... ?]

Martin Smith * Employee of FLAC * FLAC supplies gear boxes * very important as BTP want to develop the system

James Timpson * Employee of powercon * co-ordinating the project between FLAC, Powercon and BTP * Does see to it that every person is informed and takes opinion from all

Q4

BTP - does the sea trials of the ship FLAC - supplies the gear boxes Powercon - provides the pump

Q5

Could not find the other [x] it [x x] martin smith send all mails t powercon and show own colleague and james timpson forwarded his suggestions to BTP

F.6. Volunteer F

Q1

A sea trial of the installation procedure of a mechanical system had been carried out from 09-12 March 2007. The companies involed were BTP, Powercon and FLAC. The mails sent among the companies initially were of the nature of thanking for each others cooperation in the exercise. Several concerns and issues pertaining to the design of the system as a whole as also the mechanical components were discussed among the companies and also within the companies.

Q2

- Concern with the design not being smart
- Issues with pressure of propulsion inlet side
- Filter size concersn of motor and generate sides

Q3

- James Timpson - Powercon
- Tom Wilson - BTP
- Martin Smith - FLAC

Q4

BTP mechanical company (ship)

Powercon mechnical consultancy

FLAC design specialists

Q5

[Not answered]

F.7. Volunteer G

Q1

The email thread is about BTP, Powercon and FLAC are discussing the improvements on the Reduction Gear and Propulsion Motor L.O. Systems. Powercon and FLAC gave suggestions and comments on BTP's proposal of the system.

Q2

BTP has to provide 25 micron filter on propulsion motor side and generator side.

Q3

James Timpson - Project director of Powercon

He communicates with people in other companies as well as relavent people in his company. He asks for their advise and comments.

Martin Smith - General Manager of FLAC

He gives comments for the proposal.

Charles Hake - Project Manager of BTP Ship Building [?]. He requests comments on proposal.

Q4

BTP To test and build ships, improve the systems involes

Powercon Supplying motors to BTP

FLAC Supplying gear boxes to BTP

Q5

Email from James Timpson is repeating the comments from Martin Smith's email, and giving some information on the control and training parts.

F.8. Volunteer H

Q1

FLAC company wants to [?] the lubrication system and [?] of that BTP company gave then a solution and the solution: [?] they need to add a [?] for lubricating the pump. And in the email thread they talk a [?] is this [?] is working or not.

Q2

They change the Mechanical parts and the Control System as well. They find out that they need to change hardware and software made as well.

Q3

James Timpson Project director of powercon

Tom Wilson BTP - Manager of BTP

Martin Smith Manager of FLAC

Q4

FLAC The company that need the changes

BTP The company that proposed the new system.

Q5

In Martin's email he discusses about mechanical parts but in James's he talks about mechanical and control and traning as well. And in the final email from James he look more open to the system and see everything that need it are he make the [?] for the company on that email.

F.9. Volunteer I

Q1

- Successful sea trials of L.O. system (for reduction gear & propulsion) motor
- Proposed changes to improve performance (2 additional pumps)
- Improved system reviewed & accepted
- Additional software requirements identified.
- Confusion over updated design

Q2

- Booster pumps (electric) included to provide permanent operation
- 2 alternating pumps

Q3

- James Timpson, Project Manager, Marine & Offshore division, Powercon Ltd.
- Tom Wilson, General Manager, Ship Outfitting design Dept., BTP
- Martin Smith, General Manager Dept., HS (FLAC)

Q4

- BTP - Sea Trials, L.O. system (lubrication oil?) supply & design
- Powercon - overall responsibility for propulsion system design

Q5

James is more brief, but essentially same info in 1st part of the email.

F.10. Volunteer J

Q1

BTP plan to develop a L.O. System to improve the existing one. James need to make sure Martin agree on any changes. Tom need to provide a quotation for any changes to their customers.

Q2

After the discussion related to BTP's e-mail, the new proposal related to the L.O. System has been agreed with a few modifications. Tom will provide a new quotation for these changes later on.

Q3

- James Timpson: Project Director - provide opinions & thoughts on the L.O. system.
- Tom Wilson: General Manager - try to obtain views from different people & set up a price for the L.O. System.
- Martin Smith: He tried to comment on issues raised by the others.

Q4

Tom's organisation is responsible for reaching agreement on any modifications & setting a price related to these changes. Jame's organisation is responsible for the drawings and any technical issues related to this design.

Q5

The difference is that any changes Martin will be informed by James. James want to see whether Martin agrees on these changes or have other opinions.

F.11. Volunteer K

Q1

The emails are initiated by the boat manufacturer (BTC), after the sea trials -¿ a design revision they wish to improve the lubrication oil system to the reduction gear box propulsion motor. The emails are a subsequent discussion with PowerCon (Motor manufacturer) and FLAC (Reduction G/B manufacturer), both internally and inter-company emails.

Q2

- and 2 LO pumps suck direct from LO sump yank
- LO booster automatically starts
- ST-BY pump automatically change over

Q3

- James Timpson (Powercon) Liasons with customer and [x] info to design team - Project Director. Generally friendly emails.
- Tom Wilson (BTP). Short emails, responds by using original emails and inserting answers.
- Martin Smith (FLAC). Interfaces with Powercon / without including BTP in emails.

Q4

BTC

Boat manufacturers

- Design & assemble
- Sea trials
- Gas trials
- Boat owners liason

FLAC

- Reduction gear box manufacturer
- Berlin = R/G Maker
- Frankfurt = Bearing Maker

Powercon

Propulsion motor manufacturers

Q5

James' final email to Tom (BTP) answers / asks questions within capability, lets Tom know key dates & is up front with assumptions & limitations of what he can answer.

Martin, got information, send to Powercon team and James then forwards this on to Tom on the 15th.

F.12. Volunteer L

Q1

BTP have done testing & consequently want to make some changes. The thread follows input from Parties in charge of developing the parts which one proposed to be changed.

Q2

Final state of changes.

Powercon, FLAC & Control related side of BTP in still discussing with each other the [x] details of changes to be made.

Q3

Charles Hake

The project manager who has [x] members of PowerCon & FLAC to make sure proposed changes following testing are viable/feasible

James Timpson

In charge of PowerCon side. He is deals with viability of changes relating to motors.

Martin Smith

In charge of FLAC side deals with viability of bearings.

Q4

BTP

Control systems relating to testing (T Wilson) and Testing (C. Hake)

Powercon

Deal with motors & propulsion

FLAC

Deal with bearings

Q5

Smith's email: information is contracted in one main body with discussion & presentation of a list of points.

Timpson's email: Timpson isolates & deals with points individually through the use of sections.

F.13. Volunteer M

Q1

A ship is being built or repaired. One of the companies involved (BTP) proposes some modification to the original design and wants to know the idea of the other companies involved about the possibility of the new design and the stops to be taken for that.

Q2

Q3

- James Timpson (From PowerCon)
- Tom Wilson (From BTP)
- Martin Smith (From FLAC)

Q4

PowerCon Provider of the powertrain and Control Systems.

BTP The Company which is building the ship. They are who have added new features to the design.

FLAC The Company who provides subsystems to PowerCon

Q5

F.14. Volunteer N

Q1

The oil flow to the motors was not sufficient at low speed. BTP proposed a olution that required a further pump to be insaled. This also required PowerCon to modify its HMI.

Additional pump fitted and HMI modified

Q3

- [X] - SHI design manager - shipyard
- [X] - Design authority for the motor manufacturer
- [X] - Project managment of supplier and main contractor
- [X] - Design manager of gear box supplier

Q5

Control para and training added. [X] had additional information from KA and added more details on the oil type.

F.15. Volunteer O

Q1

BTP wish to change LO system for Rev Gear and PM. The pumps want to provide 2 PowerCon motoros for PM LO in a different config. This requires word from PowerCon, to be charged as [...] mod. The changes have been reviewed by supplier (FLAC) discussed and confirmed by BTP.. Queries of “Smart Design 25 Micron Filter outstanding”. Extra PowerCon costs not yet agreed. FLAC not convinced by changes but accept customers wants them. [Comment] about which part of FLAC “agreed to BTP”.

Q2

- Mech / [...] change agreed
- Settings of pressure valves agreed
- Automation changes to be discussed

- Filter grade to be discussed further with view to reducing spec

Q3

[X] PowerCon Project Director

[X] BTP Project Manager

[X] FLAC specialist

Q4

BTP shipyard design build

FLAC bearings specialist/supplier

PowerCon motor automation supplier

Q5

Marks email left out discussion by [X] advising benefits of splitting motor bearing lube from gearbox lube as [system] is compromised.

F.16. Volunteer P

Q1

BTP proposed change to add pumps for motor lub oil system. PowerCon consulted PowerCon system designers and bearing manufacturers. Some specific points were clarified including operational details, flow rates, pressures and filtering. BTP provided confirmation of specific details.

Q2

Booster pumps for permanent operation Pressure 2.8 Bar may be adjusted in commissioning

Q3

[X] BTP provided proposal

[X] - FLAC bearing manufacturer view

[X] - PowerCon Project Manager

Q4

BTP Ship builder

FLAC Bearing suplier

PowerCon Prop motor system supplier

Q5

FLAC raised issues of oil grade. Not mentioned by [X]

F.17. Volunteer Q

Q1

BTP wants to modify the Lube oil system for the propulsion motor, and submitted a scheme to PowerCon and FLAC. This was generally approved by PowerCon and FLAC, with more detailed control aspects to be discussed shortly.

Q2

The two new pumps, along with the other mechanical parts, can be installed as planned by BTP. PowerCon's control and HMI modifications are yet to be quoted to BTP but this will follow after discussion with the relevant engineers have taken place.

Q3

[X] Project manager at PowerCon

[X] General Manager - ship systems at BTP

[X] General Manager at FLAC (reduction gearbox manufacturer)

Q4

PowerCon Control and HMI for the ship systems, along with drives and motors for propulsion

BTP Shipbuilder

FLAC Suppliers of reduction gearbox for propulsion

Q5

[X]'s final email includes comments related to the scheme proposed by BTP, and all the mechanical considerations.

[X]'s email summarises [X]'s comments and adds considerations for the control/HMI aspects, along with possible training requirements.

F.18. Volunteer R

Q1

The thread concerns a requested modification to the L.O. system for the propulsion motors. The customer (BTP) require 2 additional pumps. There seems to be a slightly separate thread about software to control the pumps.

Comments from a supplier are put to the customer who then makes further comments, further detail is given.

There seems to be agreement even through PowerCon believe there could have been a better solution (smart design)

Q2

Additional pumps for bearing lubrication. There being continuously driven electrical ones. Addition components (by-pass lines, venting chambers, pressure limiting valves) that may be surplus to requirements.

Control strategy agreed plus some changes to HMI.

Q3

[X] PowerCon Project Manager

[X] FLAC General manager

[X] BTP Project Manager

Q4

FLAC Supplier of pumps and associated gear

PowerCon Main supplier of customer

BTP Customer

Q5

[X] email contains data on control aspect and training.

[X] contains extra detail about oil viscosity and gives more explanation as to why the solution is not as "Smart" as it could be. But acquieces to customer always being right.